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Castings Help to Hitch the Horse to the Wagon

ALTHOUGH the credit for making the first saddle appears to belong to the men of ancient Greece and Rome, it remained for an American to perfect a process for casting saddle and other harness hardware. Early in the nineteenth century, Seth Boyden, an inventive genius living in Newark, N. J., produced the first buckles and bits from annealed malleable cast iron and it was not long

Many Saddles Are Required To Show Western Life in Motion Pictures

before the product was used almost exclusively in the manufacture of harness. As the movement for better roads gained way in the more thickly settled sections of the country, the harness and saddlery trade progressed and in the early seventies the industry began a period of almost phenomenal growth, due largely to the invention of labor saving devices which enabled manufacturers to produce goods at a much lower cost. The value of harness and saddles manufactured today reaches a surprising total, when the development of the automobile as the bearer of man's burdens is considered. The value of these products, which include saddles and parts, harness and parts, halters, turf goods, feed bags, etc., was $42,113,300 in 1923, the last year reported by the department of commerce, as compared with $55,558,-612 in 1914 and $62,630,902 in 1900.

Find Where Castings May Be Sold

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By

Pat Dwyer

Specializes in Dryer

CASTINGS for the dryer shells or hollow rolls used in paper mills constitute a highly specialized branch of the foundry industry. They vary in length from a few feet up to 20 and in diameter from 12 inches to 60. The metal thickness in the rough castings varies from 1 to 1½ inches, depending on the overall size of the casting. This thickness is reduced by approximately ¼-inch in the subsequent machining operation. Customer's requirements for these castings are unusually severe. The entire outer face is machined and must present mirror like surface. The casting must be steam tight since it is filled with steam and maintained at a fairly high temperature while in use. The casting must balance to run easily.

From the foregoing outline it is apparent that the castings must be molded and poured with the greatest care. The molding equipment, materials and methods must be adapted in a special manner to insure satisfactory castings. The iron must be held to a close analysis and melted under ideal conditions to insure a clean, homogeneous texture in the comparatively thin wall of the casting.

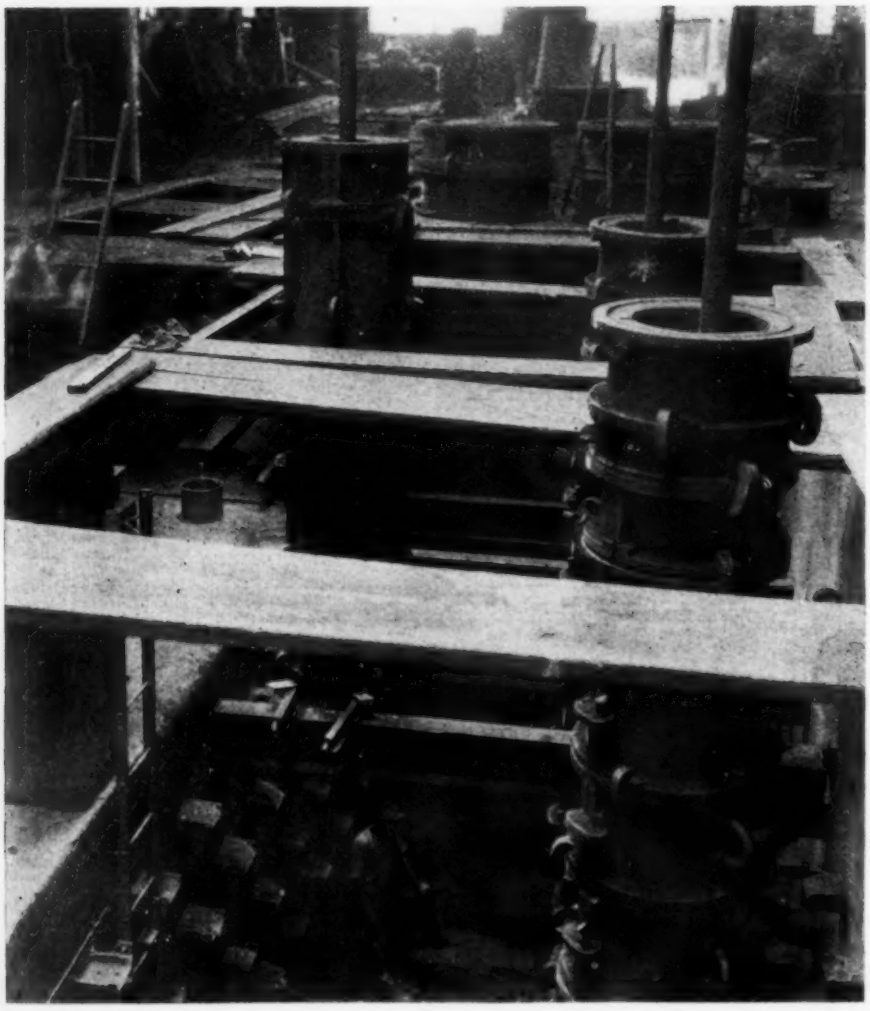


FIG. 1—SHORT MOLDS ARE SET UP ON I-BEAMS EXTENDING ACROSS THE PIT

Black-Clawson Co., Hamilton, O., has been engaged exclusively for many years in the production of paper-mill machinery, particularly the fourdrinier machine containing a great number of hollow, heated rollers over which the material for the paper passes in its evolution from a mass of liquid pulp to a continuous sheet of paper several feet in width and practically without any limit in length. For convenience in handling, newspaper rolls are cut off in lengths from 3 to 5 miles.

Following the big flood of 1913 when the Miami river rose 30 feet above its usual level, inundated every town and city in the valley, wrecked bridges and carried away everything movable, the Black-Clawson Co., erected the present foundry and equipped it in a special manner with reference to the peculiar character of the majority of castings. Roughly speaking the foundry floor is laid out

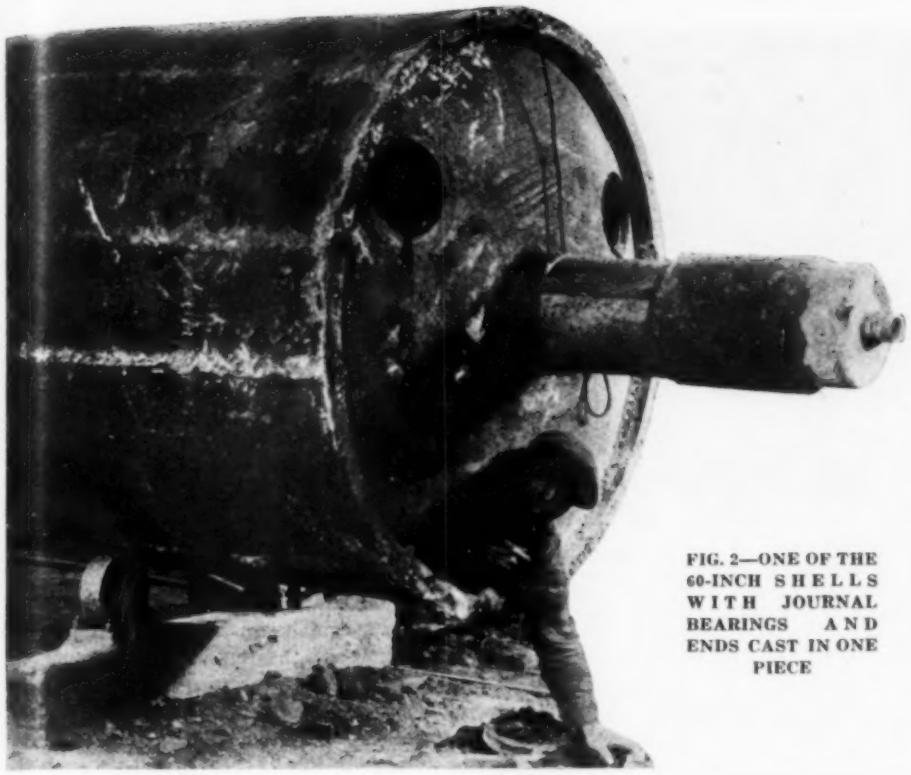


FIG. 2—ONE OF THE 60-INCH SHELLS WITH JOURNAL BEARINGS AND ENDS CAST IN ONE PIECE

Shells for Paper Mills

¶ Great Accuracy and Perfect Metal Required in This Exacting Work

in four main divisions. Dry sand molds are made at one end, the core making department is next, followed by the green sand department. Castings are cleaned in the space between the green sand department and the end wall. The two cupolas are located at one side of the building at a point between the core makers and the green-sand molders.

The foundry 60 x 300 feet of brick and steel construction adjoins the machine shop at one side and is lighted through windows at both ends and through a continuous window

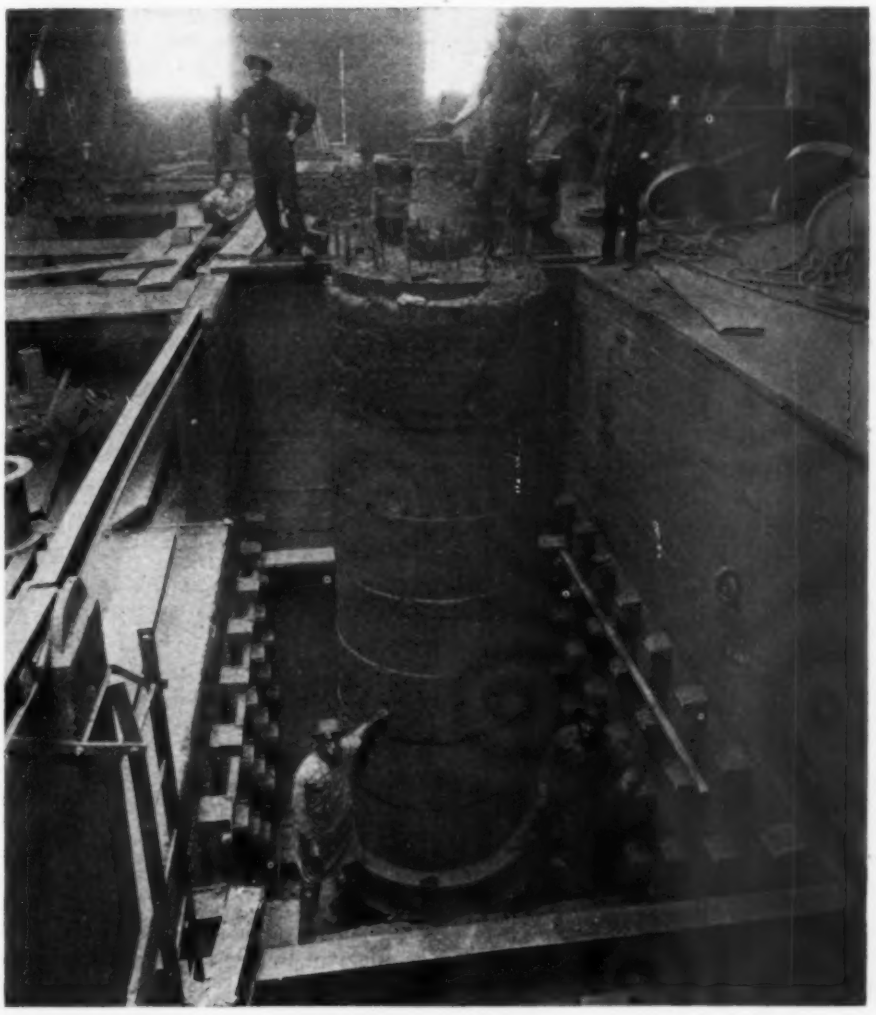


FIG. 3—LARGE CASTINGS ARE STRIPPED IN THE PIT

along both sides above the level of the crane runway. A space outside the north wall is roofed over and contains the sand mixing room, the small and miscellaneous coreroom, the core and mold ovens, the cupola room and charging platform.

Four, 15-ton cranes made by the Niles Crane Corp., Philadelphia, facilitate lifting material and equipment, and incidentally direct attention to the fact that flasks, patterns, coreboxes, arbors are of heavy, substantial cast iron construction and therefore beyond the capacity of manual labor.

The coreroom is equipped with a jib crane electrically operated to take care of the numerous small lifts.

Molds for the side frames, bars, brackets, plates and other parts of paper making machinery are made in green sand. Beyond the fact that they are finished carefully to produce clean castings, accurate in shape and size, they present no particular points of interest. Equipment and methods for making the dry sand molds and cores for the dryer shells differ in many respects from conventional foundry practice. The heads are cast in as integral parts of the shells and in that particular they differ from practically all castings of a similar character cast elsewhere. In other foundries the heads are cast separately, then machined to fit and afterward bolted to an internal flange

provided for the purpose at each end of the cylinder. The operation of casting the heads in place entails a certain risk, but it effects a substantial saving in the subsequent machining operations. Besides it obviates any possible risk of future leakage at the junction between the head and the body of the casting.

Two methods are employed for molding the dryer shells. Up to 24 inches diameter the mold is made vertically in a round iron flask made up of many sections. The core is made and dried horizontally in halves, afterward it is assembled, turned up on end and placed vertically in the mold. In the larger sizes the core is rammed inside the iron ring or tube which serves for a pattern for the outside part of the mold. Thus mold and core are formed at the same time. They are separated during the drying period, but are reassembled afterward in a deep pit with perfect accuracy.

Concrete lined pits shown in Figs. 1 and 3 facilitate handling these long vertical molds, cores and castings. The molds are made in the pit nearer the end of the building. The other pit is reserved for closing the molds and pouring them. This arrangement falls in logically with the straight line idea of commencing operations at one end of the foundry and moving steadily toward the other end where the castings are cleaned and shipped to the machine and erection shops.

The pits are 20 feet deep to accomodate the longest molds. Ends of steel I-beams projecting from the concrete walls on each side, as may be noted particularly in Fig. 3 serve as supports for the shorter molds. Lengths of I-beams cut to the exact width of the pit are lowered into place at any desired height and the mold

FIG. 5—AN IRON PATTERN IS USED FOR THE DRAG

is assembled in such a manner that the pouring basin will extend a sufficient distance above the wall of the pit to clear the ladle. The lip of the ladle is brought close to the basin to prevent any disturbance and to insure a steady, gentle stream.

Perhaps the simplest and therefore the clearest method of describing the methods and equipment employed in making the mold for a large shell is to follow one of the molds in regular sequence of operation from the time the order is received in the foundry until the casting is shipped to the machine shop.

Cast-iron patterns similar to those shown in the back ground, Fig. 5, are available for all the standard sizes. The pattern is only 3 or 4 feet in length, but may be drawn in the mold to make any desired length of casting. Cast-iron coreboxes, similar to the one shown in Fig. 4, are provided to correspond with the various sizes of patterns. The core made in this box merely serves as a foundation. The remainder of the core is built up inside the pattern. One of the cores is shown immediately back of the corebox. The position will be reversed when it is placed in the mold. An iron sleeve is rammed inside each of the three projections to assist in carrying the load. This also furnishes a solid bearing when the bolts are tightened which anchor the core to the bottom of the mold. The corebox is provided with a trunnion on each side by which it may be lifted and turned over by the crane. The pipe standing in the center of the corebox forms a vent opening through the center. On the short dryer cores a single bolt extending through this opening serves to anchor the core to the mold. On the larger and longer cores a long bolt extends through each of the three feet on the bottom of the core.

Assuming that the foregoing part of the core has been made and dried, the molder rams the drag part of the pattern in a flask similar to that shown in Figs. 5 and 6. This pattern corresponds to the end of the dryer. The central spindle, known under various names as bearing, neck, journal, gudgeon, etc., forms an integral part of the pattern, but the three projecting members on which the core

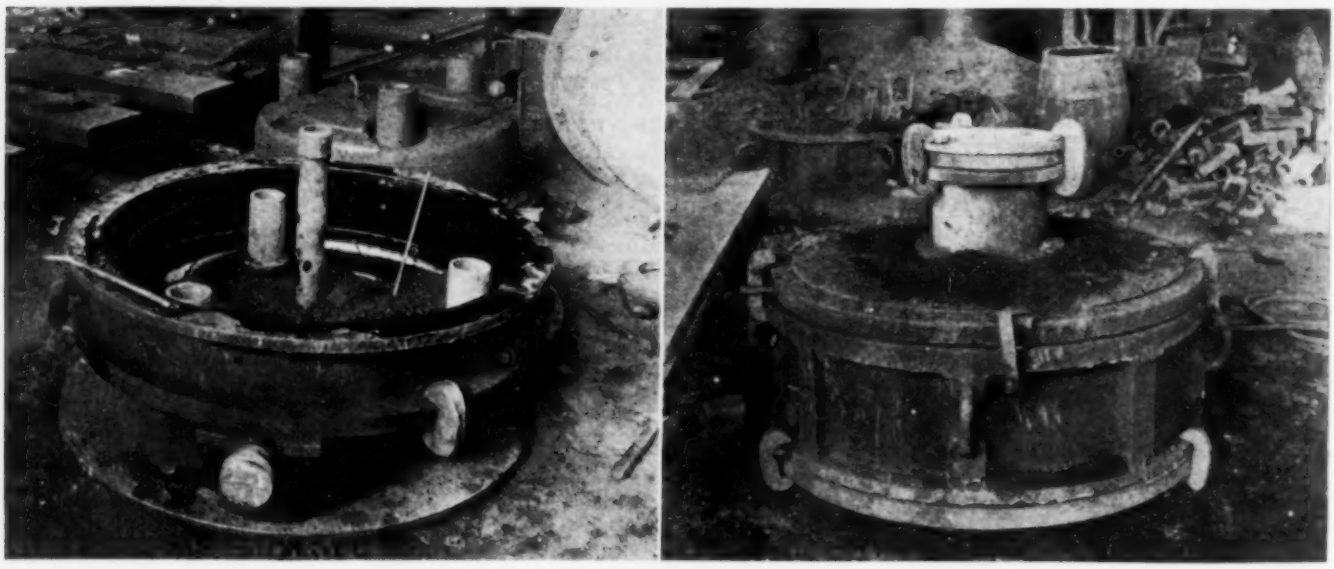


FIG. 4—CAST IRON SLEEVES ARE PLACED INSIDE THE THREE FEET TO ASSIST THEM IN SUPPORTING THE WEIGHT. FIG. 6—ONE OF THE DRAG MOLDS AS IT APPEARS BEFORE IT IS ROLLED OVER

is to rest, are attached to the pattern by suitable guides. This feature is shown in Fig. 5. A special little extension on the bottom plate contains the sand rammed around the spindle. The bottom plate is attached to the drag in such a manner that it rests firmly on the three core prints. Three holes in the bottom plate are located accurately over the three core prints on the pattern. Bolts for anchoring the core and the vent from the entire core pass through these three openings.

The drag ready to roll over is shown in Fig. 6. The same drag inverted and with the main part of the pattern removed is shown in Fig. 5. The nicely balanced pattern is suspended by a central eye bolt from the crane chain. The loose pieces forming the three projections on the bottom are lifted out by hand and packed away with the remainder of the pattern until they are needed again. A wedge or two placed judiciously under the drag serves to level it before the pattern is drawn up out of the sand.

This part of the mold is finished and blacked, after which the core referred to previously and shown in Fig. 4 is lowered into place. The comparatively long projections fit closely in the prints. They serve the double purpose of guiding the core accurately into place and automatically sealing the openings so that the iron may not leak past later. The drag then is lifted by the crane and placed in the ramming pit where the bottom plate will rest on a pair of I-beams at a suitable distance from the top.

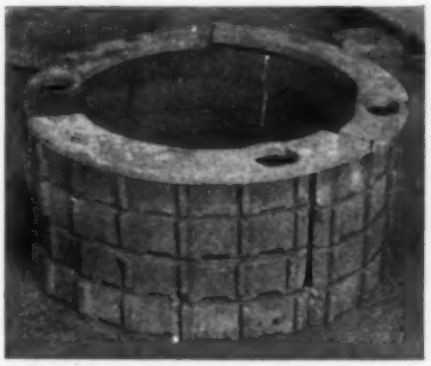


FIG. 8—TYPE OF ARBOR USED IN LARGE CORES

The distance usually is equivalent to the length of the proposed casting. For example in the comparatively short flasks shown in Figs. 1 and 7 it may be noted that the bottom only extends about 4 feet below the floor level, while in Fig. 3 it is apparent that the bottom of the flask rested directly on the bottom of the pit.

Draw the Pattern

The ring pattern designed to form the body part of the dryer is lowered into place on the drag. It is guided into position by the core and by a circular ridge left on the face of the drag by the drag pattern. A section of flask then is assembled around the pattern and sand is rammed inside and outside. Each section of the flask is split in two parts vertically for convenience in assembling and taking apart. The pairs are clamped together and to each other as the mold progresses upward. A piece of 2-inch pipe 4 or 5 feet long is placed upright in each of the three vent holes in the dry sand core and a light arbor or crab similar to those made in the open sand molds shown in Fig. 10 is packed down on top of each course of sand. The pipes are withdrawn after the core has been rammed to the top. They leave a passage for the anchor bolts and for the gas generated in the core when it is surrounded by metal. The arbors reinforce the core and help it to resist the pressure of the molten metal.

Lifting pressure on one of these cores is so tremenduous that the foregoing type of arbor is not considered secure for any but small and short castings. Reinforcing equipment shown in Fig. 8 is employed on the large and long dryer shells. This inner curbing is built up to the desired height and crowned on top by the plates which in turn engage the upper ends of the long anchor bolts. The various rings are made in sections so they may be removed readily through the small openings in one end of the castings. The light arbors in the small castings are broken into small pieces during the process of cleaning the casting and the pieces are removed with the core sand.

Before commencing to ram the mold and core, the pattern is leveled on top across the four cardinal points as represented by the side and end walls of the pit. By leveling the top of the pattern each time it is drawn upward, the perpendicular line of the pattern is kept reasonably true. How-

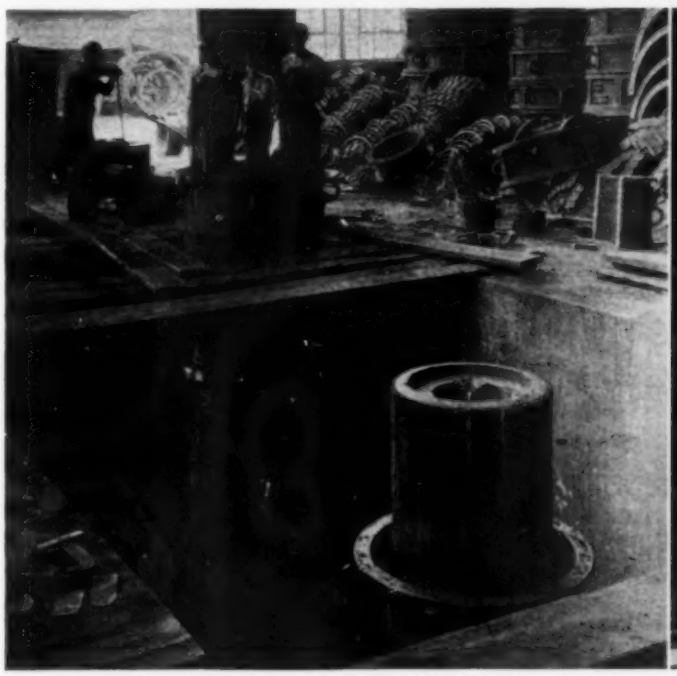


FIG. 7—WOOD PATTERNS ARE USED FOR FORMING THE OUTSIDE OF THE MOLD FOR THE SMALLER SIZES. THE PATTERN MAY BE DRAWN TO ANY DESIRED LENGTH. FIG. 9—CORES ARE RAMMED INSIDE THE PATTERNS AND BOLTED TO THE BOTTOM BEFORE THE PATTERN AND CHEEK ARE REMOVED

FIG. 10—CAST IRON ARBORS ARE MADE IN OPEN SAND MOLDS

ever, a fairly positive check is kept on this feature by only drawing the 3 or 4-foot pattern upward about 1 foot at a time. With 2 or three feet of the pattern constantly bedded in the sand, the chance of error is slight. A somewhat coarse grade of local sand is employed for the inside and outside of the pattern. The space between the pattern and flask usually is so small, from 2 to 3 inches, that this prepared sand is used here exclusively. The interior of the core is rammed full of coke and heap sand.

When the mold and core have been built up to the desired length of the casting, a parting is made around the outer edge of the pattern at the top and a dome shape is imparted to the top of the core by a suitable strike. A cover pattern then is placed in position. It is domed in the center to rest on the sand. The outer edge forms a continuation of the straight wall of the main pattern. Usually it is 4 or 5 inches high and serves as a dirt catcher. This part of the ring eventually is cut off in the machining operation. This cover pattern also carries the spindle or journal which projects through the cope several inches beyond the required casting length. In this manner the top of the journal becomes converted into a sink head or feeder. It is not covered. In the smaller castings the pipe on which the core is built, projects through the center of the riser.

Iron is poured through a ring of thin, flat pop gates spaced at suitable distances apart around the top of the rim. The gates are fed from a circular runner basin incorporated in the cope and dried with it. The size and number of gates vary of course according to the size and weight of the casting. For example where six gates ½ x 1 inch might suffice on a shell 12 inches in diameter, four times that number ¾ x 2 inches are placed on a 4-foot diameter casting. Every effort is made to maintain a nice balance between a set of gates that will fill the mold rapidly and one that will not drain the basin faster than it can be filled from the ladle.

In taking the mold apart the cope is removed first. The upper part of the pattern comes with the cope and is removed after the cope is rolled on its back. The main pattern then is drawn up for the last time. This time it is drawn up clear of the mold and placed in some convenient place on the floor until it is needed again. At this point more than at any other the advantage of ramming the core at the same time as the mold becomes apparent. The core is anchored solidly to the bottom and the face is perfectly concentric with the face of the mold thus insuring a uniform thickness of metal.

The check of the mold, in one or two sections, depending on the length is lifted, finished, blacked and placed in

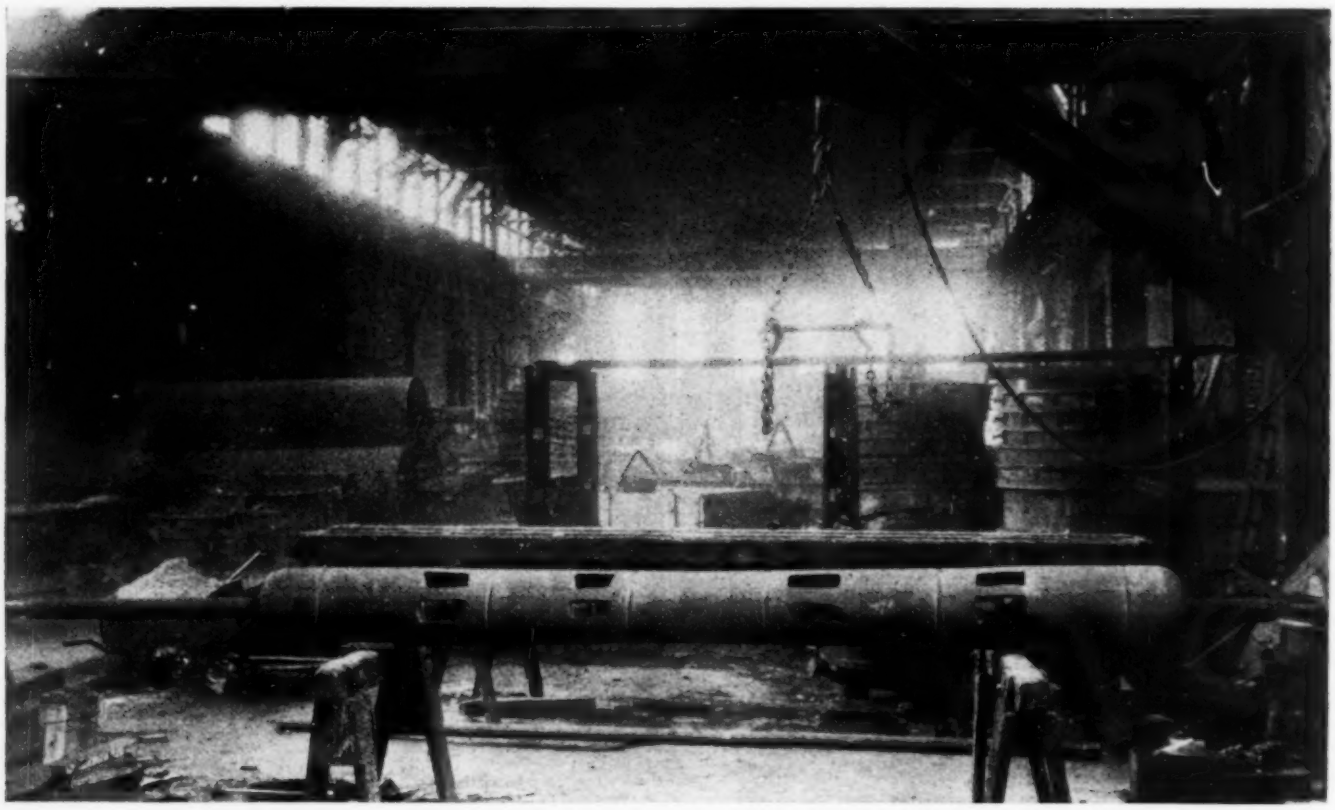


FIG. 11—DRY SAND CORES FOR SMALL SHELLS ARE ASSEMBLED ON LONG PIPE ARBORS PROVIDED WITH ANCHORING FLANGES

the oven. The exposed core is treated in a similar maner. Unfortunately no long cores were in evidence the day the pictures were taken. However, the four short cores shown in Fig. 9 illustrate the general features to which reference has been made.

Small Shells Differ

A slightly different method is adopted in making the molds and cores for the smaller shells. A wood pattern similar to that shown in the foreground Fig. 7 is employed to form the outside of the mold. It is drawn up to any desired length and loose ends are employed to form the drag and cope impressions.

Method for making the cores, anchoring them in place and providing for expansion of the arbors present several interesting features. A typical core is shown in Fig. 11. It has been rolled on its side to show how the collars are anchored on the arbor to prevent the core from slipping upward under the pressure of the iron in the mold. The pipe arbor is welded to a 1½-inch bolt at the end shown to the right in Fig. 11. This is the end that fits in the bottom of the mold. The head of the bolt serves to support the weight of the core on the bottom plate of the mold. The end of the bolt projects through the bottom plate and when the nut is screwed tightly over a washer the core is anchored definitely. The upper end of the arbor is left open and serves to conduct the gas out of the core during the pouring period and afterward. A thickness of loam is swept on the pipe at each end, between the point which marks the end of the casting and the point where the pipe becomes concealed in the sand body core.

The main part of the core is rammed in a half corebox and the two halves of the core are dried on separate plates and afterward pasted and wired together. Highly refractory sharp sand bonded with oil is used for these cores. A piece of pipe the same diameter as the arbor is bedded in and then removed from the joint face of the half core to form an impression for the reception of the arbor later. Several openings are cut through one half core as shown in Fig. 11. These openings and the channel along the center are filled with molding sand before the half core is rolled over on the plate. After the half core is dried the molding sand is removed.

In assembling the core, the two halves are rubbed face to face to a bearing while the lower half is supported on a pair of horses or other suitable support. The upper half then is removed temporarily until the joint has been smeared with paste and the arbor has been located accurately with regard to the distance the bearing at the end is from the end of the main core. The upper half then is returned to place and bands of wire are wound around the two halves in notches filed for the purpose. The joint of the core and these notches then are daubed with slurry.

Cast iron collars are attached to the arbor to prevent the core from slipping downward by its own weight or upward with the pressure of the iron. If that was the only feature to consider the collars might be attached permanently. Unfortunately the factor of expansion must be considered. On the smaller cores, wood pins are employed to hold the collars in place. Cast iron pins extending through the collars and arbors are used on the larger sizes. Core sand is packed around the collars through the openings in the core, then the openings are filled, the entire core is given a coat of blacking and placed in the oven for a final drying.

The finished core is lifted by the end of the arbor and lowered into the mold in the pit, where the lower end is bolted to the bottom plate and the top is centered by the cope. The metal in the casting is set before the arbor begins to expand. The pins break under pressure and the arbor expands straight upward without distortion.

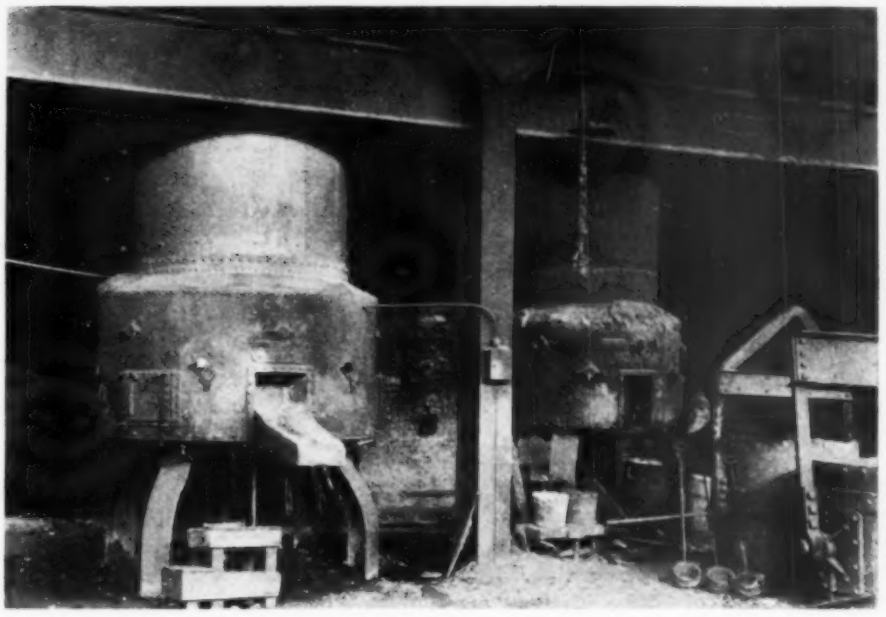


FIG. 12—THE 60-INCH CUPOLA TO THE LEFT IS USED CONTINUOUSLY. THE 48-INCH CUPOLA TO THE RIGHT IS MAINTAINED AS A SPARE

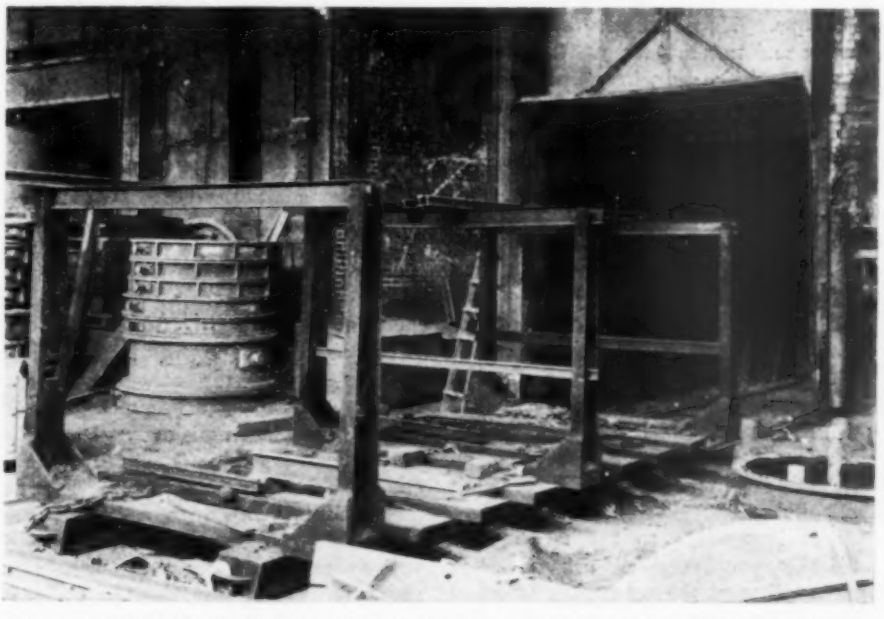


FIG. 13—THE CORE AND MOLD CARS MOVE ON A ROW OF CAST IRON 6-INCH BALLS IN V-GROOVE BEARINGS INSTEAD OF ON THE CONVENTIONAL TRUCK WHEELS

Outlines

Rational Cupola Practice

Uniform Grade of Cast Iron or of Special Metal To Meet Specifications Hinges on Manner of Operating Cupola

By E. J. Lowry

ADVANCES in many directions have been made in the cast iron field and yet little improvement has been made in cupola design or method of operation. The most radical change noted recently is the application of a heated blast and the trial of twin cupolas with a common receiving chamber between them. However, neither of these designs has been accepted to any extent up to the present. Foundrymen proverbially are skeptical in accepting evidence that conflicts with custom and tradition.

Dismissing this point for the moment, foundrymen often have wondered why some standard method has not been developed to prevent the vagaries of melting. Almost every man knows that periodically he gets a continuous run in which the iron shows little life, or where pin holes and dirt appear on the surface of the castings. Periodically he runs into this trouble and runs out of it without really learning the cause.

The most unfortunate feature is that the foundryman gets out of trouble without knowning why. A recurrence makes him feel that it is normal. His reluctance to solving the problem lies in the fact that it costs considerable money to investigate his conditions. He is interested in production and not in theory. Often, too, if he were to run an investigation, the irons used or the coke burned during his troublesome period would be used up and his conditions changed.

Variation in cupola melting is due perhaps largely to the variation in combustion in the cupola. Combustion is caused by burning fuel when air is introduced through the tuyeres. It is essential the fuel is burned completely as possible to carbon dioxide to impart high temperature to the iron. Speed of gases through the cupola should be as constant as possible to maintain an even rate of melting and movement of stock through the cupola.

It is impossible to lay down dogmatically any rule or set of rules which will meet the conditions of every cupola. It is not so much the fact that the cupolas are so different that causes this condition as it is the changes in the materials which are used in one cupola as compared with another.

As an instance consider scrap: Foundry *A* may be a stove plate foundry working on light small castings, whereas foundry *B* may be working on heavy machinery castings. Even though both foundries may have the same size cupolas, the character of the scrap entering the charges is different. Foundry *A* would use light weight stove scrap weighing perhaps 50 pounds maximum, whereas foundry *B* would be using heavy machinery scrap weighing upwards of 150 pounds. In some cases 500-pound pieces are not unusual.

THIS article is abstracted from a paper by E. J. Lowry presented at the annual convention of the Ohio State Foundrymen's association held in Cincinnati, Sept. 16 and 17. The author is connected with Hickman, Williams & Co., Chicago.

Light open scrap melts readily and and does not impede the flow of gases, whereas the heavy, blocky pieces choke the cupola and prevent proper combustion, with a bad effect upon the melt. Two different cupolas have been taken in this instance, but one cupola might be given as an illustration. In this case the type of scrap would be variable. In one charge, light scrap would be placed and in the other charge heavy scrap would be thrown. This condition causes trouble because the bed is burned away rapidly while melting the heavy scrap. When the subsequent charge of light scrap reaches the melting zone, the bed is too low and the iron becomes oxidized.

Scrap has been picked out to illustrate this point, but pig iron also can be a troublesome factor. For example, if the pigs in a car load average 105 pounds, the melting loss will average 2.75 per cent. The temperature of the iron will be approximately 2585 degrees Fahr. and the melting ratio will be approximately 6.55:1. This melt will average approximately 8 per cent loss in silicon, 17 per cent loss in manganese, 10 per cent loss in carbon and the sulphur pick-up will be 33 per cent. However if the pigs average 77 pounds in weight the melting loss will be 2.55 per cent. The temperature of the resulting iron will be 2720 degrees Fahr. The melting ratio will be 7.10:1. The silicon loss will be 6 per cent, the manganese loss, 14 per cent, and the carbon loss, 8 per cent, with a sulphur pick-up of 27 per cent. It is evident from this test that the size of pigs influence the melting conditions.

Apparently if a cupola is properly designed and properly operated, that should end criticism of cupola practice. Evidence shows that uniformity of cupola design will not eliminate the variations experienced in the foundries throughout the country. For example, in *Principles of Iron Founding*, the question of good cupola operation is summed up by Dr. Moldenke as follows:

1. See that the proper amount of air gets into the cupola for its capacity.
2. See that the coke bed is dry and well lighted up before charging.
3. See that the bed is the proper height to give the "First Iron" in eight to ten minutes.
4. See that all metal charges are alike in weight.
5. See that the coke charges are no larger than requiring enough to just cover the metal below.
6. See that the coke charges are so adjusted to the metal charges that the melting zone remains stationary throughout the heat and at the right point.
7. See that the blast volume (not pressure) never changes throughout the heat, as this immediately changes the position of the melting zone.
8. See that charges are evenly distributed, pig iron over the entire bed first, then scrap also over the entire charge then coke. If steel is used, put it on before the pig. Never use thin steel scrap.

These rules are more or less the rules that the average foundry is using. They have been cited to carry out the discussion and to show the impossibility of uniform operation of cupolas.

Even though all the points mentioned should be followed, uniformity

could not be had, due to the variation in the materials. As an instance, coke is of two grades, beehive and by-product. But these two classes include any number of divisions in quality. Beehive coke is dense and metallic. In most cases it is brittle, whereas by-product coke is stronger and more open. If this comparison would only fit all grades of coke the subject of fuel could be dispensed with readily. Just because a coke is a by-product coke, does not necessarily mean that that coke is perfect. The quality of coke depends on the quality of the coal used in its making; on the coking time and on the temperature at which it is made. The size of the oven and the method of grading have a great deal to do with the quality of the coke.

Large coke gives hotter, cleaner, better iron than small coke which burns away rapidly and causes the iron to melt too near the tuyeres, thus causing dirty castings. Small coke usually is to blame for dirty castings, pin holes and misruns. These defects are due to cold iron or oxidized iron. Quality of coke varies throughout the country, and this begins the first point of the vagaries in cupola operation. For argument's sake, suppose we say that all coke used in the country is similar. Suppose we further believe that all cupolas of the country are standard. Would we be able to product uniform cast iron?

Loss and Gain

The answer is "no!" There is a difference in pig irons which reverts to the ore, the blast furnace practice and the fuel used. This difference causes a dissimilar loss or pick-up of the various elements in the remelting in the cupola. For example, one pig iron will lose 50 points of silicon on a three times melt, gain 8 points in sulphur, lose 33 points in manganese, 55 points in total carbon, and gain 24 points in combined carbon, whereas another pig iron will lose but 8 points in silicon, gain 4 points in sulphur, lose 23 points in manganese, and lose 23 points in carbon, with a pick-up of only 8 points in combined carbon.

Just this variation in the loss of elements would cause the analysis of similar castings made in two foundries using these grades of iron to be different, that the hardness might be kept the same. In investigating ten different pig irons it was found that their oxidation losses were all different. It was found further that in some instances strong pig iron became weak on remelting, and weak pig irons became strong.

In some instances little change was effected on melting. In these tests the pig iron was analyzed for 27 different elements in an effort to find some reason for these changes. The chart of these analyses shows that there is little difference in the rarer elements found in pig irons. Consequently, the difference found on remelting cannot be traced to the rarer elements. The differences have been traced to the operation in the blast furnaces. Pig irons made under a lean lime slag and with all other conditions good gave the best results. Experiments were made with pig irons containing scrap and those without scrap. Where the scrap was used in the blast furnace and used properly, the pig iron often was bettered in quality.

Dirty Pig Iron

Another condition which affects cupola operation is the physical condition of the pig iron. Foundrymen are familiar with spongy top pigs. A melting experiment has shown that ¼-inch scruff on top of the pig increased the melting loss practically 15 per cent and increased the silicon loss 3 per cent, the manganese loss 3 per cent, the carbon loss 2 per cent and the sulphur pick-up 5 per cent. Where the scruff is ½-inch deep on top of the pig, the melting loss was increased about 60 per cent. The melting ratio was decreased from an average of 6.55:1 to an average of 6.35:1. The silicon loss was doubled and the manganese loss was increased 7 per cent, the carbon loss was increased 7 per cent and the sulphur pick-up increased 9 per cent. Taking the same ½-inch scruffy top pig, a decrease in the coke ratio to 5.75:1, brought the melting loss and change in elements back to practically normal. Here is another variable which enters into cupola operations.

Experiments with pig iron melted in a cupola and poured into castings have shown definitely that the pig iron influences the carbon formations in the castings. These experiments have shown further:

1. That machineability is a factor related to the type of irons in the mixture, some irons requiring double the amount of power to perform machining operations.

2. Pig irons are a factor in the production of hardness, and this hardness, is a combination of graphitic carbon growth and combined carbon.

3. That combined carbon is not directly related to brinell hardness nor is it related to machineability.

4. There is an inherent expansion and contraction in the pig iron that continues through to the casting.

5. Wear is not a function of hardness nor of combined carbon. It is primarily a function of carbon form.

Some of these statements are contrary to the views of engineers on hardness tests, machineability and wear. Automotive engineers claim that a hardness tests is the true criterion although a brinell hardness of 150 in cylinders has required a machining factor of 65. The same brinell hardness on a block made with charcoal irons required 33. The analyses were the same. Engineers believe combined carbon is the principal factor in deciding hardness, but in their own laboratories they find 0.45 per cent combined carbon associated with a brinell of 140 to 207. Engineers fool themselves, the same as buyers of castings. They look at the proximate result rather than the ultimate. High grade castings save money in machining iron, costs, upkeep and overhead.

Engineers claim that wear is a function of combined carbon. The contrary has been proved. Just because a substance is hard it does not hold that it wears well. Wear is a function of colloidal substance of the iron which is based upon carbon forms. To say that it is a function of the pearlite matrix is debatable. The work of Honda, Hayes and Wakefield shows that the carbon percentage in this structure varies with the total carbon and silicon present in the iron; hence, a variable character in wear.

Special Types of Iron

A great deal has been said about pearlitic irons and alloy irons. These all have their fields. Estimable strides have been made in them. Better irons result in some cases; but wouldn't it be better to develop a good cast iron and then give to it added quality by such methods rather than to detract from the advantage of the alloy by a poor grade iron? In other words, use the alloy to gave quality and not as a panacea for trouble.

Surrounding this development of good cast iron comes the important question of melting temperatures of materials. The average foundryman says that consistent results cannot be obtained when materials of widespread analyses are placed in a mixture. He glances askance at silvery irons. How can an 8 per cent silicon iron used in small percentages in a mixture give results? He fails to realize that on account of the tempera-

ture at which the *silveries* melt they must be placed nearest the fuel charge and in small pieces. Because he has thrown silvery irons into the cupola helter-skelter and received mis-shapen results from his practice, he condemns the irons. Sometimes, he loses considerable money by purchasing the higher silicon grades of coke irons to the elimination of silvery. This holds true for other materials.

Steel scrap is used because one does not know how to overcome troubles in any other way. This practice is not to be condemned because the material is the cheapest a foundryman can employ to get a close grain casting. The machine shop suffers. Use of steel scrap means the easiest course. The best course would be to know the metallurgy of the situation and employ proper grades of pig iron.

Some progress has been made as shown by the change in kinds of pig irons used in the past 12 years. The change has been slow because there is but an 8 per cent difference between 1912 and 1924. However, an increase of 20 per cent is shown in the tonnage of malleable bessemer iron used. This change was uneconomical and in the wrong direction. High phosphorus irons are the cheapest to make from the country's economic position. They also make the highest grade wearing irons as shown by foreign diesel engine blocks. If we expect to compete with such blocks greater attention must be paid to utilizing high phosphorus irons. We accept the lower phosphorus irons because we know so little of the effect of carbon-silicon phosphorus.

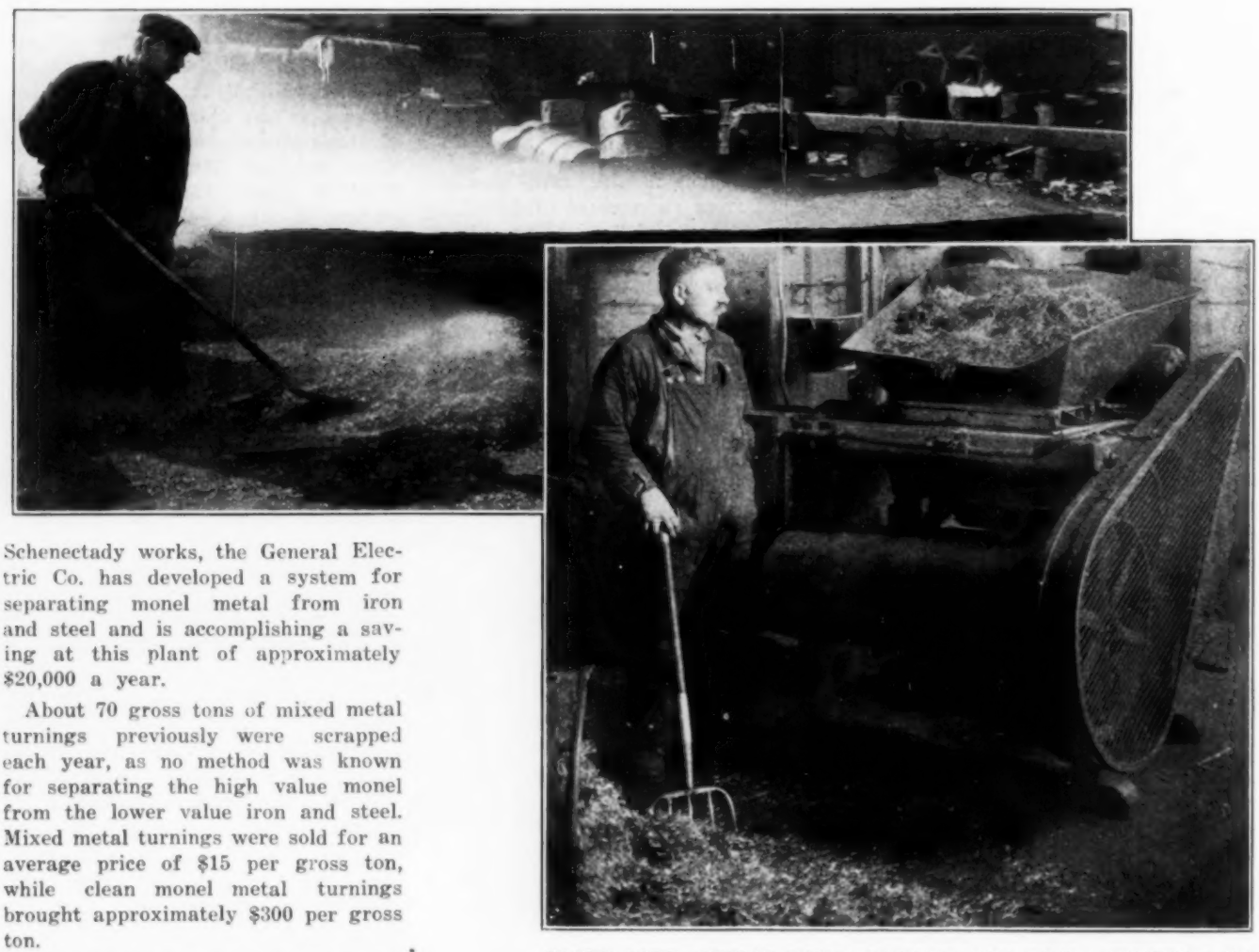
Separates Mixed Scrap Mechanically

IN machine shops handling monel metal as well as iron and steel, considerable difficulty sometimes is experienced in preventing turnings from becoming mixed. Monel scrap commands a price about 20 times greater than iron and steel, while mixed scrap brings but little more than the usual prices for ferrous materials. Confronted with the problem of salvaging mixed scrap at its Schenectady works, the General Electric Co. has developed a system for separating monel metal from iron and steel and is accomplishing a saving at this plant of approximately $20,000 a year.

About 70 gross tons of mixed metal turnings previously were scrapped each year, as no method was known for separating the high value monel from the lower value iron and steel. Mixed metal turnings were sold for an average price of $15 per gross ton, while clean monel metal turnings brought approximately $300 per gross ton.

Many methods of separating the two kinds of scrap had been tried without success, including the use of magnets. The magnetic method was not successful because the monel metal was picked up along with the iron and steel. Finally, by using a rheostat on the magnet and reducing the current to a minimum, a point was reached where the iron and steel was picked up and the monel metal dropped. This separating device equipped with a rheostat is shown at the lower right in the accompanying illustration.

During cold weather a clean separation was difficult because of oil congealing on the turnings and holding the two metals together. One of the plant workmen suggested that the turnings be dried on large steel plates with fires beneath, as shown in the cut at the upper left. This method was tried and found to be most satisfactory under all existing conditions.



(UPPER LEFT)—DRYING MIXED FERROUS AND MONEL TURNINGS ON HOT STEEL PLATES. (LOWER RIGHT)—THE MAGNETIC SEPARATOR IN OPERATION

Power Sand Mixers Replace Hand Labor

From a Wide Variety of Sand Mixing Equipment Now Available, the Foundryman Is in a Position to Select the Type Best Fitted to His Particular Requirements

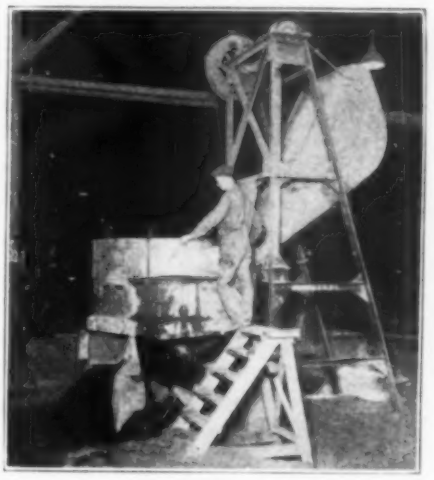


Fig. 1—Muller Equipped With Loading Bucket

MECHANICAL sand handling equipment has been adopted so extensively in the foundry in recent years that a brief reference to some of the machines developed to take the place of the man with the shovel appropriately follows the series of articles on sand reclamation presented in consecutive issues of THE FOUNDRY from March 1 to May 15. This equipment ranges all the way from an ordinary riddle clamped in a vibrating or jolting frame, up to an elaborate system of sand mixing, conveying and distributing machinery capable of treating all the sand required in a foundry with a capacity of several hundred tons of castings per day.

Foundry sand presents a peculiar feature not found in any other manufacturing industry. Clay comes into the brickyard or the pottery works where it is manipulated and pressed into shape, passed through the kilns and shipped out as a finished product. Blooms and billets enter the rolling mill and emerge in any one of a hundred different shapes to meet customer's specification. Trees of the forest are floated to the mill, converted first to pulp and then to paper. The general practice obtains almost universally with all raw material destined to meet the three main demands of mankind, food, clothing and shelter. There is no back tracking. The material may be changed from one shape to another, but the progress is steadily in one direction. If anything goes wrong with the process the material cannot be thrown back into its original state, or started once more at the initial stage in a definite cycle of operation.

Not only is it possible to throw sand back into its original state, but the process actually is obligatory. The greatest care is taken to prepare the sand so that it will take and retain a definite and highly finished shape and impart the reverse of that shape to a body of metal that is introduced in a molten condition. Once the mold has served its purpose it is of no further use, but the sand has to be broken down, treated with water, elaborately mixed and rejuvenated and brought to its former state of uniform perfection before it can be used to make a second mold. The process is continuous in many instances and in others it is intermittently continuous in that it is repeated at least once a day during the period of the foundry's activity.

Instead of being classed as a raw material and an active ingredient in manufacturing operation, sand more properly should be included in the category of silent servants which stand and serve. It ranks with bodies of water supporting cargo boats and rails over which freight and passenger trains whirl to their destinations. It is only a means to an end, a conveyor, a flexible kind of a

FIGS. 2 AND 3—TWO TYPES OF SELF-PROPELLED MACHINES DIFFERING CONSIDERABLY IN CONSTRUCTION DETAIL AND TO SOME EXTENT IN THE MANNER IN WHICH THE POWER IS TAKEN FROM A GASOLINE ENGINE OF ELECTRIC MOTOR, BUT SOMEWHAT SIMILAR IN THEIR METHOD OF MIXING THE SAND WITH A SET OF REVOLVING BLADES. THE MACHINES ARE MADE IN SEVERAL SIZES

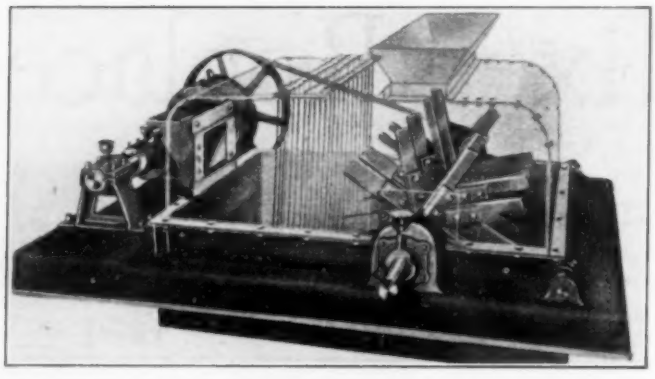


Fig. 4—Phantom view of a machine for revivifying sand

die that is made up and used once, then destroyed and made up again with the process repeated indefinitely.

Riddles of various forms and sizes are the simplest of the many devices used in the foundry for the preparation of sand. Some are round, some are rectangular, some are stationary while others are revolved, rotated or driven back and forth in a manner that slightly approximates the movement of a riddle agitated by hand.

Simplest of all riddles, certainly the oldest is the wire screen with one end resting on the floor and the other end supported at an angle of approximately 60 degrees from the horizontal. This type of riddle still is used extensively for screening sand for cement, plaster and mortar on construction jobs. It is also used to some extent in the foundry, particularly where a great many of the molds are made in pits in the floor and where it becomes necessary to separate the sand from the coke after an old bed is dug up. It presents one advantage over the ordinary hand operated riddle in that only one man is required to operate it. He throws the material high up against the screen and separation is accomplished by gravity as the material rolls toward the bottom. The sand falls through the meshes of the screen while the coke or other coarse material collects in a mound at the foot of the screen on the working or face side.

Several types of power operated riddles are used in the foundry and in the core room. Some are operated by compressed air through a reciprocating motion that jerks the riddle back and forth on suitable slides. The apparatus is portable and may be shifted from place to place if necessary on the floor. Under certain conditions it may be advisable to leave the riddle in one place and take the sand to various points after it has been prepared. Others depend on electric current usually supplied through a flexible cord attached to a lamp socket. This type of riddle may be suspended from any convenient support and allowed to remain as a fixture or moved from place to place. A small motor imparts a reversible gyratory motion which causes the sand to fall rapidly through the meshes. The average capacity of one of these riddles is about 8 cubic feet per minute.

Where large quantities of sand are handled continuously, screens of the horizonal revolving type have been installed with satisfactory results. These screens vary to same extent in diameter and length depending on the volume of sand to be treated. Also the perimeter conforms to either one of two main shapes. The majority of foundrymen seem to favor a plain round barrel and presumably this shape also is favored by the manufacturer since it is easier to make. However, a considerable number of foundrymen have specified barrels with five, six or more sides and claim they get more rapid action with this type. So far as we know, no authentic tests have been made to determine the relative merits of the two types of barrels, but since the published description of all the recent large installations indicates that round barrels have been selected we are justified in assuming that this type yields satisfactory service and meets the requirements of the majority of users.

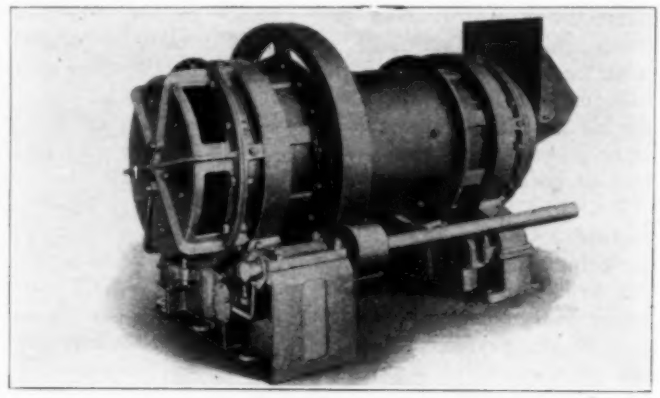


Fig. 6—A Mulling Effect Is Secured Through a Number of Loose Rollers

Rigid and substantial construction is essential in a screen through which several hundred tons of sand are passed in a day. The end rings are supported on rollers in a cradle and in that manner no weight is imposed on the center shaft and spiders which impart motion to the screen. A large opening is provided at each end of the revolving screen which is mounted on a slight incline. Some form of conveyor, usually a belt, feeds sand through a chute into the upper or higher end of the screen. Centrifugal force and gravity carry the tailings through the lower end into a suitable container for final disposal either on the dump, or, in some cases to a reclamation plant where the lumps are crushed and the sand rebonded for further use.

Up to the present, continuous foundries, that is foundries in which the same space and the same flasks and the same sand are used several times

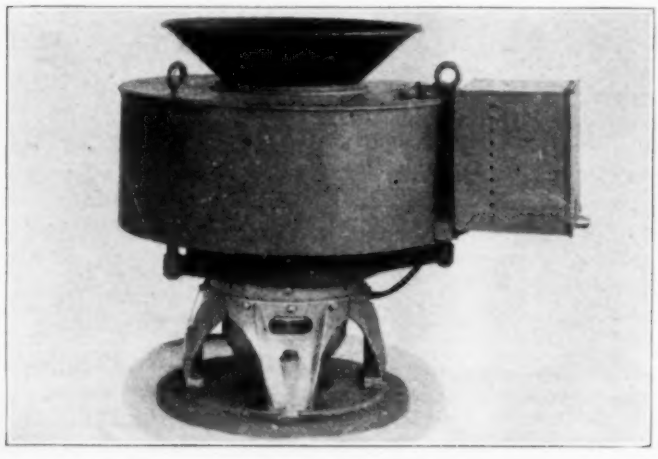


Fig. 5—Centrifugal Machine in Which the Horizontal Plate Is Equipped With Upright Prongs

each day, only include a small part of the total number of foundries in existence. Central sand preparation and distributing stations are the exception rather than the rule. The advantages of the system appear to have gained more general recognition in recent years and in all probability it will be adopted widely in the future. In the meantime other mechanical appliances have been developed and find a wide and ready application in foundries where the sand still is prepared for use on a number of individual floors.

Fig. 8—Self-Contained Traveling Machine Which Gathers, Mixes and Packs the Sand in the Flasks

Portable Sand Cutters

Two of the more popular types of sand cutting machines are shown in Figs. 2 and 3. They are made in several sizes and equipped either with gas or electric motors. A series of spiral blades mounted right and left hand on a central shaft engage the sand, toss it in the air from two opposing sides and in that manner approximate the action of two experienced men cutting a sand heap over with shovels. While the action is the same the speed of operation is in the same ratio as the motion of a picture shown at normal speed and one shown at the speed known as *slow motion*. Comparison is not confined merely to speed. Superiority of the machine is even more apparent in the condition of the sand. The highest degree of skill is required on the part of a man who mixes sand with a shovel. This type of man is not available in every foundry and as a result about 75 per cent of the scrap may be traced directly or indirectly to improperly prepared sand. Where the sand is cut over mechanically this hazard is removed. The sand is blended thoroughly. Recently several foundries have used this machine to carry on reclamation work by adding clay to old sand.

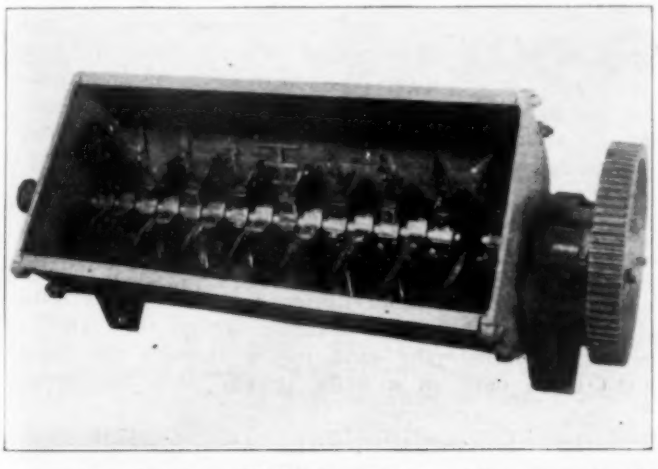


Fig. 7—Paddles Toss the Sand From End to End in This Mixer

In many foundries the sand cutting machine is employed only at night to prepare the sand and arrange it in the familiar long windrows extending from the gangway to the wall or from one gangway to another depending on the size of the shop and the layout of the floors. In others it is employed to cut the heaps over several times a day and frequently between busy periods it is utilized to mix batches of core sand or facing sand. By running the machine over the heap a few times the sand may be piled up close to the machine or bench or in a position where it may be picked up readily with a grab bucket suspended from a crane and conveyed to any desired point on the foundry floor and dumped there.

The machine shown in Fig. 8, a development of the past few years occupies a peculiar position in the foundry field. Several manufacturers of foundry equipment have concentrated on machines for mixing and conveying sand, for filling flasks with sand and for ramming that sand in the flasks. Each of these factors has been treated as a separate unit. The machine shown in the illustration combines all these activities in itself.

An All Around Machine

Mounted on two rails laid on the floor the electrically operated machine moves back and forth from one end of the track to the other. Flasks to be filled and rammed full of sand are arranged in a row paralleling the track. After the molds are poured the flasks are shaken out between the rails where the sand is wet down in any convenient manner. The machine passes over it once tossing the sand into a long regular pile. The double screw horizontal conveyor and the bucket elevator shown at the rear end of the machine in the illustration Fig. 8 then are lowered and a sufficient quantity of sand is placed in a central tank to keep the machine running for some time.

From the central tank the sand passes by elevator, screen and belt

Fig. 9—Prepared Sand From the Paddle Type Mixer Is Dumped Into a Waiting Bucket

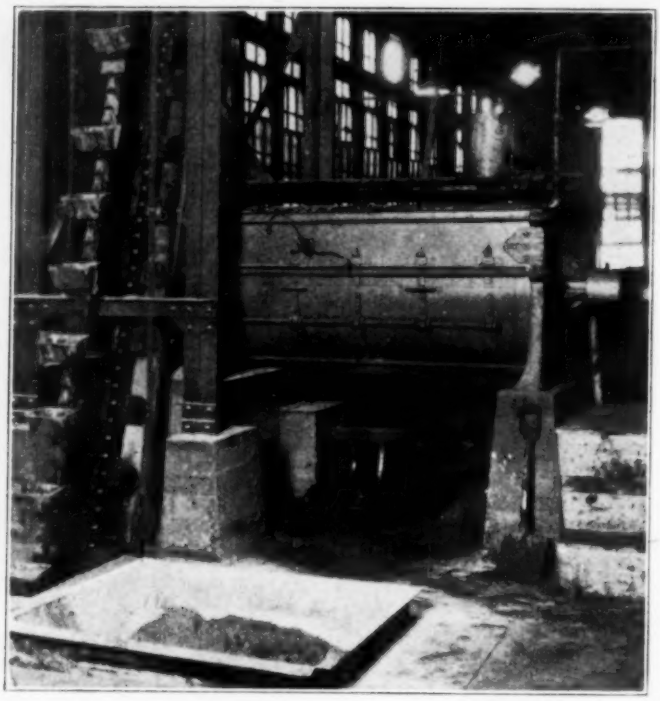


Fig. 10—After the Sand and Binder Are Shoveled into the Hopper in the Floor, the Machine Does the Rest

to the distinctive feature of the machine. In fact this is the feature around which the machine has been developed. A rapidly revolving paddle which strikes the falling stream of sand and drives it into the flask with sufficient force to pack it to the required density. From the foregoing brief description it is apparent that the machine is a self-contained unit capable of taking care of every step in the production of a mold from the preparation of the sand to the point where the mold is ready to be taken apart for the removal of the pattern. In addition to the type shown in the illustration, the machine is made in several smaller sizes, both stationary and portable.

A portable type of sand mixing machine made up of a hopper, steel sprigged belt and revolving brush, a machine made in several sizes is shown in Fig. 11. The combined principles of harrowing, gravity and centrifugal force are utilized in the operation of the machine. Sand is shoveled into the hopper in which the bottom is formed by a rapidly moving endless belt studded with steel loops. The loops comb the bottom surface of the sand, the small particles of sand fall between the loops and all foreign material gravitates toward the lower end of the hopper where it may be removed while the machine is in motion. Centrifugal force exerted at the upper point where the belt emerges from the hopper and passes around the pulley, discharges the fine sand from between the loops. The sand is aerated by being thrown through the air for a considerable distance in a fluffy stream.

Auxilliary Machines

A larger machine of the same type is equipped with a long trough, a feed screw and a small bucket elevator in addition to usual equipment. Sand may be shoveled by hand or dropped from a grab bucket into a trough where the horizontal feed screw propels it to the elevator and thence into the hopper which contains the traveling belt.

A somewhat similar device has been placed on the market to be used in connection with a pan mixer in which the sand is prepared under a pair of revolving rollers. After the sand leaves the mixer in the usual manner through the discharge gate it is passed through a device known as an aerator. Here it impinges on a steel drum provided with a great number of projections ½-inch diameter and ½-inch high. This drum revolving at high speed throws the sand through the steel bristles of a stationary brush set immediately above the cylinder. The sand passes through the brush in a fluffy stream while the gravel

FIG. 11—A PORTABLE MACHINE MAY BE AIMED TO DISCHARGE SAND INTO TUBS OR TO ANY DESIGNATED PLACE ON THE FOUNDRY FLOOR WHERE IT MAY BE NEEDED FOR THE DAY

and any other foreign material falls back over the drum into a chute that conducts it to the floor.

One of the earliest types of machines developed for mechanically mixing sand is shown in Fig. 5. Originally it was designed to be driven by a pulley and belt, but a later model is equipped with an electric motor. Sand is fed into the hopper at the top of the machine and falls on a revolving table provided with a great number of long vertical prongs. Centrifugal force throws the sand toward the rim of the plate and on the way it strikes a succession of prongs. As a result it falls in a fine shower from beneath the hood, free from lumps and homogeneous in texture and mixture. The machine is used for mixing either core or molding sand and has a capacity of approximately 10 tons per hour, or about the amount that two men can shovel. The output of the machine may be increased if suitable provision is made to feed sand to the hopper in a continuous stream and to remove it from beneath the machine as fast as it accumulates.

The idea of driving sand through a series of rods set up in such a manner that the passage of the sand is continually obstructed has been adopted in a direct or modified form by many makers of sand conditioning machinery. In a recent British model the revolving plate is mounted vertically and the sand falls through a maze of rods attached horizontally to the plate. In a model employed by a prominent manufacturer of sand handling equipment in this country the sand falls through the spokes of a lantern wheel.

Popular Types

A phantom view of a sand disintegrator and mixer installed within the past few years in many prominent foundries of the continuous type is shown in Fig. 4. Sand falls from a moving belt into the hopper and upon the revolving paddles which throw it horizontally through a maze of suspended rods. The aerated, disintegrated and pulverized sand falls on a second belt which carries it to a storage bin. One end of the cover is hinged to the frame and the other end is lifted a few inches with every revolution of a small cam shaft and allowed to fall back into place with a jolt that prevents the sand from sticking to the rods or to the sides and ends of the cover.

Probably the muller type of sand mixing machine is the most widely distributed of the many types of this form of equipment found in the foundry. It is made in many sizes and shows many modifications of design both here and in Europe, but the basic principle is the same in all. Sand is thoroughly mixed and blended by being subjected to the pressure of heavy rollers. The rollers in the device shown in Fig. 1 are mounted in such a manner that the entire weight does not rest on the sand. A balance is maintained whereby a mulling action is secured, but one that is not severe enough to grind or pulverize the sand grains.

Device Has Loading Scoop

In the type shown in the illustration Fig. 1 the circular pan remains stationary while the rollers revolve both on their own axes and around the pan. The device is equipped on one side with a loading scoop which discharges a measured amount of material and on the other side with a gate through which the prepared sand is removed at the close of the mixing period. Weight of the rollers and centrifugal force constantly throw the sand toward the outer wall of the pan and a pair of plows traveling in advance of the rollers as constantly throw it back in their path.

Other types of the same general class of machines show a revolving pan with the rollers attached to a fixed axle. Small pans are equipped with a single roller, but the larger sizes 6 or 8 feet in diameter carry two.

Wide divergence of opinion which seems to characterize foundrymen in their choice of equipment is illustrated in the many types of rollers that have been tried and still are in use in pan mills. Some rollers are grooved deeply on the circumference to form in effect a collection of disks with comparatively narrow faces. Others are cast with deep transverse corrugations on the face and resemble gear wheels with the teeth laid out to an abnormal pitch.

A sand mixing machine of the pan and roller type which attracted considerable attention was shown as part of the exhibit of a molding machine manufacturer at the Syracuse, N. Y. convention of the American Foundrymen's association in 1925. Two tapered, corrugated rollers with the small ends in the center revolved in a stationary pan and worked the sand toward an opening in the side. A revolving brush on the outside at this point caught the sand and threw it in a fine shower into an elevator that carried it aloft and discharged it into a storage bin over the molding machine.

Although used to a considerable extent for mixing facing sand, the machine shown in Fig. 10 is used principally for preparing core sand. It may be used with or without the mechanical sand handling equipment. An interior view of the mixing trough Fig. 7 shows the number and position of the paddles set at opposing angles to each other. With the paddle shaft turning 20 revolution per minute it is apparent that the 32 paddles toss the batch of sand 640 times a minute or 1920 times during the 3-minute period usually devoted to the purpose. A lighter machine made by another manufacturer in which the trough is tipped over to discharge the load of prepared sand is shown in Fig. 9. Actual mixing of the sand is conducted on practically the same principle.

A type of sand mill that has figured prominently in several recent large installations is shown in Fig. 6. It is an adaptation of the clay mill peculiar to the clay working field. It is mounted on a slight incline and the sand is fed into one end and automatically discharged at the other end. A water spray is attached to the charging end of the barrel and the stream of sand is sprinkled as it enters. While this mill is based on the mulling principle, the application of the rollers is different from any other devoted to the preparation of foundry sand. A number of pieces of 3-inch steel shafting serve as rollers and ride with and in the sand.

Company Is Incorporated

Nevada-Pacific Minerals Co., Las Vegas, Nev., has been incorporated under the state law of Nevada. The company was organized to produce silica sand for steel foundries, glass plants and for use in the building industry. Molding sand for use in gray iron, brass and aluminum foundries also will be produced. Officers of the company are: Malcom Crowe, Los Angeles, president; Harry E. Blood, formerly manager of the Mineral Supply Co., Los Angeles, vice president and general manager; C. E. Louden, formerly with the Mineral Supply Co., secretary and treasurer; A. S. Henderson, Las Vegas, assistant secretary. Balfour, Guthrie & Co., Los Angeles and San Francisco will be selling agents for the new firm.

Lee & Clark, 549 Washington boulevard, Chicago, has been appointed representative of the Pennsylvania Pump & Compressor Co., Easton, Pa., in the Chicago district.

Gases Affect Soundness of Castings-I

By E. Longden

SOUNDNESS increases progressively with a reduction in mold gases. From this deduction it would follow that, if we cannot eliminate these gases altogether, provision must be made for their speedy evacuation through the pores of the sand and vents.

When molten metal enters a sand mold, large volumes of gases are generated from combustible materials and chemical decomposition of substances composing the mold, to which can be added gas occluded by the cooling metal. To minimize the effect of such gases on the soundness of castings forms an important part of the molder's work. Great care and ingenuity are exercised in conducting gas away from cores and molds.

Causes Defects

Defects which could be attributed to gases are numerous and are caused by: Insufficiently dried cores and molds; hard-rammed cores and molds; lack of ramming locally, since a pocket of loosely-rammed sand provides an easy exit for the gases generated in the harder surrounding sand and the gas easily flows forward into the mold cavity and metal; abuse of the swab locally; too much moisture in the sand; lack of the natural venting properties of molding sand; omitting artificial venting; improper use of the vent wire; faulty sand mixing; faulty and wrong mixtures of mold dressing; allowing metal to penetrate vents in core or mold; choking of vents by sand; blow holes from inserted solid metals such as denseners, chills, nails, studs or chaplets; blow holes from wet loam stamps which are placed on cores to make up the common errors in size between core and mold print; absence of openings and risers for removing mold gases quickly; insufficient fluid head pressure; incorrect gating so that metal has such a tortuous passage that it becomes lifeless and unable to expel collected gases, for the very act of pouring tends to create blow holes because of agitation; omitting to feed metal through riser gates to replace escaping gases, and dull iron because there is always more difficulty in obtaining castings free from blow holes when the molds are poured with sluggish iron.

Molding materials from which gases are generated are worth attention. What are termed *natural molding sands* before preparation consist of substances in something like the following proportions: Silica 78 to 92 per cent, clay matter 6 to 14 per cent, oxide of iron 2 to 5 per cent, lime 4 to 25 per cent, magnesia up to 1 per cent and water up to 10 per cent.

Sands are specially prepared for facing the metal. When mixing facing sands, other materials are added such as coal dust, manure, sawdust, hair and artificial binders like core gum, molasses, flour, sugar, resin, vegetable and mineral oils, etc. Then we have the various refractory materials which are applied to protect the face of the mold and give a good finish to the casting such as plumbago, charcoal and mineral blackings, ground silica, core gum, etc. Each of these materials has special virtues when rightly used, and give the combination of properties required in molding materials. The desirable ones being, refractoriness, porosity, plasticity, adhesiveness, cohesiveness, and resistance to distortion at high temperatures.

Most successful sands and refractories are those which have these properties with the maximum connected pore spaces around the sand grains for gas exit when metal enters the mold. Sands and refractories may lose as much as 15 per cent by weight when subjected to molten metal temperatures and the facing sand for a considerable depth from the surface is much changed in physical properties, chiefly due to ignition and burning of coal dust and organic matter, and dehydration of the iron oxide and clay bond. Water (mechanically mixed) is removed at a low heat, and the water of combination lost at a temperature of dull red heat.

Forms Gases

These chemical changes are accompanied by the formation of large volumes of gas. Hydrocarbons are decomposed by the hot metal, and graphite deposited on the face of the sand. If the sand is too damp and graphite is not deposited, it would account in some instances for the burning-on of sand as in the case of loam and dry-sand molds which have been insufficiently dried. Steam is discharged from the surface of the mold and is decomposed by the hot metal, and probably the oxygen combines with the graphite at its ignition temperature thereby robbing the mold surface of its refractory cover resulting in the gray-burnt-on sand appearance. With green sand in the ordinary way, carbon from the coal dust would appear to combine with the oxygen which is liberated when water is split up into its elements, and also with the oxygen in the pore spaces of the sand; the pore spaces in good molding sand being about 25 per cent of the bulk and in cores about 40 per cent. Likewise the combustible substances may burn in the air contained in the pore spaces and under certain

Blames Gases

THAT mold gases are responsible for a greater percentage of defective castings than has been recognized, is the belief of the author. This conclusion is based on a number of simple experiments and a fortunate and exceptional experience with small and large castings of simple and intricate design. From the evidence collected, the defects which usually are described as liquid shrinkage cavity and porosity have been credited to gases generated in the mold and those occluded by the metal during cooling. The author believes that if it were possible to eliminate mold gases, the amount of liquid shrinkage in gray iron would be negligible and the problems which beset the metal founder would be reduced considerably. The article is abstracted from a paper delivered before the Lancashire branch of the Institute of British Foundrymen. The author is foundry superintendent, Hetherington & Sons, Ltd., Manchester, Eng.

THE FOUNDRY DATA SHEET, DEC. 1, 1926

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in notebook form.

TENTATIVE SPECIFICATIONS FOR ALUMINUM BRONZE CASTINGS

1. These specifications cover alloy castings, the alloy being a composition known commercially as aluminum bronze. Two grades are specified: namely, grade *A* not responding to heat treatment and grade *B* capable of heat treatment.

I. Manufacture

2. (*a*) The bronze may be made by any approved method.

(*b*) No scrap shall be used in the manufacture of the bronze, excepting that of known composition and origin.

(*c*) The copper used in these castings shall conform to the requirements of the standard specifications for lake copper wire bars, cakes, slabs, billets, ingots, and ingot bars (serial designation: B4) or for electrolytic copper wire bars, cakes, slabs, billets, ingots and ingot bars (serial designation: B5) of the American Society for Testing Materials 1924 standards or copper of equal purity.

(*d*) The aluminum shall be that commercially known as grade No. 1, or that carrying less than 0.30 per cent of silicon. The iron shall be a pure grade of iron free from dirt or other detrimental foreign material.

II. Chemical Properties and Tests

3. The bronze shall conform to the following requirements as to chemical composition:

	Grade A	Grade B
Copper, per cent	87 - 89	89.5 - 90.5
Aluminum, per cent	7 - 9	9.5 - 10.5
Iron, max., per cent	2.5 - 4	1.0
Tin, max., per cent	0.5	0.2
Total other impurities, max., per cent	1.0	0.5

4. (*a*) An analysis of each melt may be made at the option of the purchaser and at his own expense.

(*b*) The sample for chemical analysis shall be taken from cuttings from the test bars.

This is a *tentative* standard of the American Society for Testing Materials under serial designation B-26 T, issued 1926.

(*Continued on Data Sheet No.* 648)

TENTATIVE SPECIFICATIONS FOR ALUMINUM BRONZE CASTINGS

(*Continued from Data Sheet No.* 647)

III. Physical Properties and Tests

5. (*a*) The bronze shall conform to the following requirements as to physical properties:

	Grade A	Grade B
Tensile strength, min., lb. per sq. in. (as cast)	65 000	65 000
Tensile strength, min., lb., per sq. in. (as heat treated, quenched and drawn)	.....	80 000
Yield point, min. (as cast)	25 000	25 000
Yield point, min. (as heat treated)	.....	50 000
Elongation in 2 in., min. (as cast)	20	15
Elongation in 2 in., min. (as heat treated)	.....	4

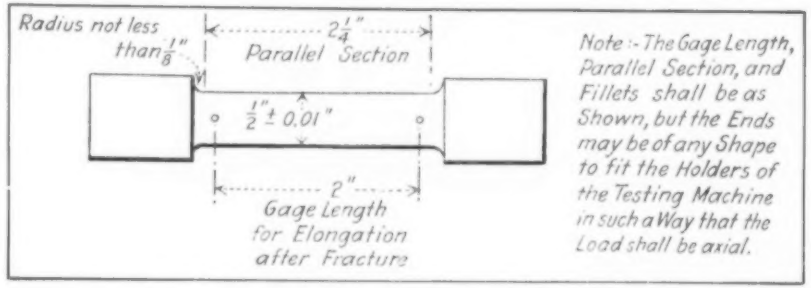

Radius not less than 1/8"
2 1/4"
Parallel Section
1/2" ± 0.01"
2"
Gage Length for Elongation after Fracture
Note:- The Gage Length, Parallel Section, and Fillets shall be as Shown, but the Ends may be of any Shape to fit the Holders of the Testing Machine in such a Way that the Load shall be axial.

FIG. 1—TEST SPECIMEN

(*b*) The yield point in tension shall be determined as the stress producing an elongation under load of 0.5 per cent, that is, 0.01 in. in a gage length of 2 in.

6. (*a*) The tension test specimen shall be machined from coupons to the dimensions shown in Fig. 1. The ends shall be of a form to fit the holders of the testing machine in such a way that the load shall be axial.

(*b*) The coupon attached to the casting or cast separately in the case of small castings shall conform to the form and dimensions shown in Fig. 2. In the case of coupons cast separately, they shall be molded in a manner similar to the castings

(*Continued on Data Sheet No.* 649)

conditions prevent burning-on of sand. The coal gas forms a film on which the metal flows thereby protecting the sand.

When considering the volumes of gases generated in a dry sand and green mold we should be inclined, when examining superficially, to state that greater volumes of gas would be formed in the green-sand mold than the dry-sand mold, but this must be modified because the cooling effect of the damp backing-sand in a green-mold will tend to reduce the volume somewhat. The heat from the metal which volatilizes the coal dust and converts the water to steam, absorbs heat for the time being thereby cooling the sand and preventing burning-on of sand.

Occludes Gases

Gases occluded by metals are stated to be hydrogen, nitrogen, carbon monoxide and carbon dioxide. Gases are noticed escaping during feeding operations, but are mainly mold gases. Instances are on record where gas emanating from pig iron after drilling amounted to 75 per cent in volume of the metal removed.

Gases have the power both of diffusing through and of being retained by solid substances. Hydrogen may be diffused readily through cold cast iron. Agitation assists diffusion, and agitation which occurs at the overheated sections of a mold or core due to gas blowing into the metal assists diffusion of gas into the metal.

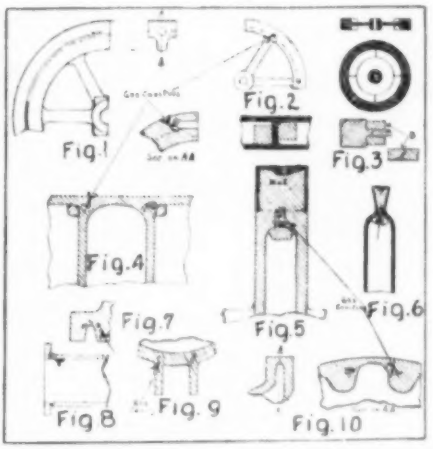
Bearing these points in mind, to say that it is not possible for reactions to take place between carbon in the metal and oxygen from the mold which might be blowing into the metal at great pressure, is a bold statement to make. Other heat-forming reactions are possible with other gases and local bessemerizing is possible. If such changes take place, it would account for the sponginess and cavity in certain sections of gray iron.

The feasibility of such reactions when considering the practicability of partly desulphurizing a ladle of molten cast iron by merely placing soda ash or sodium carbonate on the surface of the metal, is not surprising.

It does appear that the supposed liquid shrinkage in gray iron might almost be ignored if mold gases could be eliminated.

Practice of venting varies in different parts of the country, the variation being due to the quality and availability of sands and whether molding in dry sand or green sand. We can safely say that a correctly made dry-sand mold will produce a higher quality casting, both in looks and soundness, than a green-sand mold and with less risk of waste; also that a correctly made loam mold will give better results than either. It does not always follow that the loam or dry sand will be more costly to produce for in many instances a loam mold, or dry-sand mold can be made more quickly than one in green sand.

Nature of molding determines that a dry-sand or loam mold, especially the latter, will be freer venting and with less gases present than green sand. Removal of moisture in dry sand and loam creates porosity as does also the expansion of grains of sand when heated because they do not quite return to their original position. Loam when dried is very porous, less artificial venting being



FIGS. 1-10—SKETCHES OF VARIOUS TYPES OF CASTINGS WITH HOLES THAT THE AUTHOR ATTRIBUTES TO GAS DEFECTS

needed. Except when building loam around a pattern, only a thin layer is struck up on brickwork. The loam is not compressed by ramming as is the case with ordinary sands and for that reason is more open. Cinders are introduced into a loam building when necessary but sometimes the use of such material is much abused. In many instances it is far better to introduce dry sand and loam waste into cods and between the brickwork. The drying of loam is hastened materially by perforating with the vent wire so that steam can quickly pass out. The holes so formed can be stopped up after drying.

Many more vent holes are made in dry-sand molds than would be needed apparently just to help drying. When molding large castings in the floor and which are to be dried with open fires, or patent dryers, these holes become more valuable. Venting can be materially helped if, when ramming sand in the bottom boxes of large molds, after the first course is past, the pattern sand which is only damp enough that it will barely hold together is fed in, and the last course finished with the normal green sand.

Venting in green or in dried molds usually is more thorough than in loam or dry sand. Any neglect may prove disastrous because the gases are generated in greater volumes, the sand is weaker in bond and the rapidly expanding gases push off a portion of the face of the sand. If the sand face is not so detached the gas may blow into the metal and cause, if not distinct blow holes, porosity. Unequal distribution of moisture in green sand may prove fatal to the casting. Gases may pass through correctly mixed facing sand to encounter wet places in the backing sand and then return again to find lodgment in the metal or blow off the surface of the mold.

The quantity of gas given off by cores and certain portions of the mold is much greater than in a similar amount of sand forming part of the mold, and proves exacting on the vents. In the mold the gas which has been liberated and expanded by the heat of the metal is cooled somewhat when passing through the back sand; but with cores, the heating up is more rapid and intense and gases continue to generate and expand. The core if of comparatively small area may be heated up to the temperature of the metal just before setting.

Average voids formed around the sand grains is said to be about 40 per cent of the bulk. This means that the air in the pores of the sand is also expanded but much of it begins to pass out through the vents early. Later, reactions take place between the oxygen in the sand void and the oxygen liberated from the iron oxide in the sand with gases from decomposition of the carbonaceous materials. The burning out of such materials makes the sand more porous.

Liberal Venting Necessary

Vents as large as practicable should be provided to allow the gases to pass out quickly instead of blowing out through the skin of the core into the mold. The smoothing of the surface of the sand and application of refractory wash or powder helps to close up the surface pores and prevent this happening.

Molders and coremakers often pay scant attention to vents. They will place cinders in various parts of the core or mold and leave them unconnected and isolated without separate exits for gas. Vent pipes and holes

(*Concluded on Page* 958)

Investigates Heat and Scale *Resisting Cast Irons-I*

Semisteel and the Influence of Graphitizers Treated Under Subject of High Duty Castings—Discusses Annealing Processes for Car Wheels

By Oliver Smalley

REGARDED from a strictly metallurgical point of view, cast iron is an intermediate between an unrefined and a refined product. In its broad application, it is remelted pig iron and it is this complex ferrous substance which science and art have endeavored to understand and control without involving the costly processes necessary in the manufacture of the finally refined product, steel. Unfortunately the metallurgy of cast iron has been complicated so long by the unrestricted permission of the use of the name *cast iron* to any product having a ferrous base melted in the cupola, whether it be made from hot, medium or cold blast pig iron, steel, scrap or old tin cans, that it has become identified as a cheap material rather than as a metallurgical product possessing specific and advantageous properties. That such a state of affairs has been allowed to prevail comes about from the fact that this rude complex material has a use. Because of the severe service conditions demanded today, and the precise specifications of the modern engineer, its place in industry is diminishing and is being taken by materials whose properties are specific, under control, and meet the more rigidly enforced service conditions.

A diminishing field of cast irons, despite their low price, may be found in almost every branch of endeavor. Constructional, railroad, locomotive, automobile, electrical, mechanical and agricultural engineering industries are turning to steel and special alloys. The chilled iron roll is giving way to the chromium molybdenum steel roll; chemical and heat resisting castings are being replaced by costly nickel chrome alloys, steel castings and forgings; hydraulic cylinders and rams, steam cylinders, pumps, etc., are being made in ordinary and special alloy steel castings; heat treating and tempering pots, antimony and lead refining pans now are manufactured in steel and alloys, while the car wheel is losing its place to a manganese treated steel wheel.

A moment's thought on the basic position of cast iron shows that this encroachment by other materials not only has manifested itself over a number of years, but that it is to continue as long as the iron founder permits its present identification and as long as the engineer is allowed to recognize it as the cinderella of metallurgy.

Resistance to growth on heating and cooling, ability to withstand sudden changes of temperature without cracking, hot strength, superior and consistent physical properties, toughness and resistance to wear, are the most prominent problems engaging the manufacture of high duty castings. Centering around the quantity and physical form of the graphite, progress may be measured from present understanding of the chemicophysical reactions involved during graphite formation; from the information available on the behavior and effect of graphite under any given set of conditions, and from the cost of any process necessary to effect any desired result.

Thus measured, we are confronted by a situation where developments still have to emerge from an overwhelming mass of irreconcilable technical and scientific data and researches, and where prejudices of the past yet have to give way to the advances of science. However, it is well established that the more nodular the form of the graphite and the more stable the carbides under heat conditions, everything else being equal, the better is cast iron able to resist the heat and stress conditions demanded of high duty castings, and that the ideal cast iron would be a material possessing the advantageous properties conferred by the presence of free graphite in conjunction with those of the finally refined product, steel. To this end development of superior cast iron has been directed.

Cold blast and synthetic pig irons that are free from the vagaries of

HIGH duty castings and chilling irons are discussed in this article by Oliver Smalley which is from a paper presented at the Detroit convention of the American Foundrymen's association, Sept. 27-Oct. 1.

Oliver Smalley was born in Chesterfield, England in 1891. He was educated at the Chesterfield grammar school, Montgomery college, Bradford Technical college and was graduated in metallurgy and chemistry from Sheffield university. He holds a silver medal of the London City Guilds institute, a diploma of distinction and honor in higher chemistry and metallurgy granted by the British board of education and a diploma of the Institute of British Foundrymen for original research during 1922 to 1924.

Oliver Smalley

Mr. Smalley was chemist for the Cammell, Laird Co., Ltd., Sheffield, for 4 years and then served as research metallurgist for 3 years. He became connected with the Scott Engineering Co. Ltd., as chief chemist and metallurgist for 1½ years. Later he served as chief metallurgist and chief of research for Sir W. G. Armstrong, Whitworth & Co., London, for several years. Mr. Smalley came to the United States in 1924 and made tour of the country. Later he was engaged as consulting engineer for the American Brake Shoe Co. At the present time he conducts a consulting practice in New York. During the war he was a member of the special army reserve and was a second lieutenant in the British army. He is the inventor of a turbine bronze, a substitute for rubber and a wood distillation process, and is the author of numerous papers and essays on foundry and scientific subjects.

Table I

Cast No.	Per Cent Graphitizer Additions by Weight	1 Inch Square Bars — Brinell Hardness	1 Inch Square Bars — Fracture	.075 Inch Square Bars — Brinell Hardness	.075 Inch Square Bars — Fracture	.05 Inch Square Bar — Brinell Hardness	.05 Inch Square Bar — Fracture	0.35 Inch Square Bar — Brinell Hardness	0.35 Inch Square Bar — Fracture
0	Ordinary white iron; no additions*	477	White	483	White	483	White	483	White
1	1.0 Calcium-Silicide	228	Gray	241	Gray	302	Corners and edges white, center gray	364	White
2	1.0 Ferro-Silicon	286	Corners edges white, center gray	331	Mainly white, center gray and speckled white	364	White	375	White
3	0.50 Calcium-Silicide and 2.50 Ferro-Silicon	228	Gray	228	Gray	235	Gray	241	Gray
4	0.50 Magnesium-Silicon and 2.50 Ferro-Silicon Alloy and 0.25 Ferro-Silicon	239	Corners white, rest gray	364	Mainly white, center gray	418	White	477	White
5	0.75 Zirconium-Silicon Alloy and 0.50 Ferro-Silicon	223	Gray	235	Gray	321	White speckled with gray	387	White

*Before treatment, a bar six inches by 3½ inches by 3½ inches, cast in sand was white throughout. The calcium series present a sparkling gray fracture; the ferro-silicon series a similar type of fracture but lighter in color; while the zirconium series present a peculiar dark gray velvety fracture; indicative of great toughness.

fluctuation and uncertain chemical composition and the structural heterogeneity of modern hot blast furnace irons, afford obvious and well recognized advantages. They offer a starting point which facilitates the manufacture of a material of uniform and consistent physical properties, and places cast iron in line with true alloys.

Because of the high cost of special pig irons, attention was next directed to the use of steel as a corrective of the varying graphite and structural uncertainties of low grade pig irons. Among the first to publish material on this important advance in cast iron metallurgy was David McLain. Since his original work, many others, including Campion, Field and Cameron, have contributed to the knowledge of this hybrid material and because of its merits, its identification in the high duty cast iron field is increasing. At the same time, the susceptibility of steel to oxidize during melting and the limitations of the cupola as a melting unit, together with the general disregard of adequate control, are such as to place a certain limited and restricted field on semisteel.

All steel, semisteel and cold blast pig iron melted in the cupola under identical conditions to give the same resulting composition as far as total carbon, silicon, manganese, phosphorus, and sulphur are concerned, have a different structural composition, physical properties and behave differently in service. It is the au-

FIG. 1—(ABOVE)—PHOTOMICROGRAPH OF SPECIAL WHEEL NO. 1—X200. FIG. 2—(BELOW)—PHOTOMICROGRAPH OF NORMAL WHEEL NO. 2—X200

FIG. 3—(ABOVE)—PHOTOMICROGRAPH OF LOW THERMAL TEST WHEEL NO. 3—X200. FIG. 4—(BELOW)—PHOTOMICROGRAPH OF WHEEL NO. 4—X200

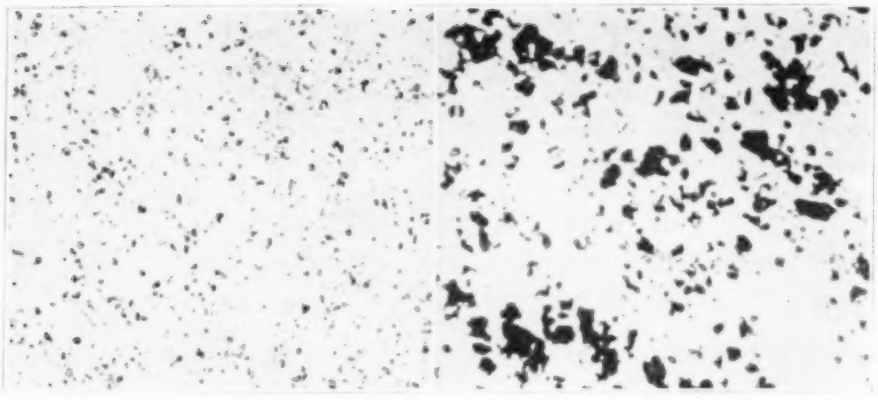


FIG. 5—(LEFT)—PHOTOMICROGRAPH OF A CASTING MADE IN AN IRON MOLD BEFORE HEAT TREATING. (RIGHT)—PHOTOMICROGRAPH OF SAME CASTING AFTER TREATING AT 920 DEGREES CENT. BOTH A AND B X 50

thor's experience that this difference is attributable to occluded gases, the chemical form of the sulphur compounds and to mechanically suspended ferrous oxide. It is this contamination which renders semisteel a close grained and consequently stronger material. At the same time semisteel lacks the low coefficient of friction, the resilience and ability to withstand sudden changes of temperature of ordinary cast iron. The practice of melting steel in the cupola —like all other methods which may cheapen cost—is too likely to be regarded as an end in itself rather than as a means to an end. It is for that reason that instead of regarding it of value as a corrective in the manufacture of a superior product when made under precise control, many founders still regard its use as one of the pitfalls of successful production.

Following McLain's use of steel, the next advance was made by J. E. Johnson Jr., who endeavored, by a bessemer converter, to blow out the silicon from one portion of his charge so that oxygen was made to enter it. He claimed this to be impossible if more than a small quantity of silicon were present. He added pig iron straight from the furnace to this blown metal and thereby restored the silicon of the whole to any desired amount without removing the oxygen. By this process, he claimed to make up an iron to any desired precise composition and properties. This new oxygen carrying cast iron (if ever it made its debut in practice) has not survived, despite the superior claims made for it.

Numerous other attempts since have been made in the direction of the application of a steelmaking process, refining sufficiently for the production of castings free from plates of graphite. Of the most recent, the Thyssen-Emmel and Wuest processes are of interest, although they yet have to be established industrially. The former claims a special modification of the working of an ordinary cupola wherein the coke consumption is less than in normal practice and where a total carbon content of less than 3.00 per cent is assured in the finished casting. Silicon is used to effect the desired graphite separation. The Wuest process involves the use of a newly designed furnace comprising a vertical shaft which is filled from above with the charge of iron and necessary fluxes to be melted. At the base of the shaft a small open-hearth furnace is constructed. Melting is performed by an oil burner using preheated air. It is claimed that the oil fuel necessary amounts to about 10 per cent of the weight of iron melted.

Table III

Details of Four Tested Car Wheels

Wheel	C.C.	G.C.	T.C.	Si.	Mn.	P.	S.	Fracture	Comments
1	.28	3.33	3.61	.69	.81	.286	.110	Black Gray	Withstood severe thermal test. Returned from service. Chill worn thin.
2	.40	3.13	3.53	.73	.53	.273	.142	Dark Gray	Withstood standard thermal test. Returned from service. Chill worn thin.
3	.66	2.84	3.50	.66	.86	.361	.138	Light Gray	Passed thermal test unsatisfactorily. Cracked in 2 minutes 5 seconds with loud report.
4	.68	2.78	3.46	.69	.90	.374	.178	Light Gray Sparkle	Failed thermal test. Cracked in 1 minute 5 seconds with exceptionally loud report.

Table II

Effects of Graphitizers on Tensile Properties

Cast No.	Per Cent Graphitizer by Weight	Per Cent Silicon in Finished Casting	Tensile Strength Pounds per Square Inch	Physical Condition
"A"	0.50 Calcium-Silicon Alloy (25 per cent Ca) (55 per cent Si)	1.0	53,060	Each bars as cast 0.75 inches diameter
"A"	0.50 Calcium-Silicon Alloy (25 per cent Ca) (55 per cent Si)	1.0	67,437	Annealed 800 degrees Cent. 5 minutes and allowed to cool over 3 hours
1	1.00 Calcium-Silicide	1.48	47,140	Each bar as cast .075 inches diameter
2	1.00 Ferro-Silicon (50 per cent Silicon)	1.24	61,184	Each bar as cast 0.75 inches diameter
3	0.50 Calcium-Silicon and 2.50 Ferro-Silicon	2.30	38,403	Each bar as cast 0.75 inches diameter
4	0.5 Magnesium-Silicon and 0.26 Ferro-Silicon	1.25	52,029	Each bar as cast 0.75 inches diameter
5	0.75 Zirconium-Silicon Alloy and 0.50 Ferro-Silicon	1.56	48,117	Each bar as cast 0.75 inches diameter

Advances in Foundry Processes

Parallel with these metallurgical and furnace advances, progress has been made in what might be termed foundry processes.

In a fundamental research published by the author it was shown "that there exists for every grade of ordinary cast iron a minimum rate of cooling during solidification which yields within practical limits the same grain or density regardless of the section or dimension of the

casting." The superior properties, accompanying irons where the rate of cooling and chemical composition have been adjusted so as to procure the desired nodular form of graphite, are well established and open up a potential field in the foundry industry. However, a distinct difference exists between the service value of castings under heat influences where the desired structural form of graphite has been secured by rapid cooling of soft irons and where it has been secured by retarded cooling of hard irons. The photomicrographs of Fig. 5 representing a casting having an analysis of total carbon 3.20, silicon 2.34 manganese 0.62, phosphorus 0.88, and sulphur 0.06 made in a long life iron mold, before and after heating to 920 degrees Cent. (1688 degrees Fahr.) show that growth is not eliminated when the graphite no longer presents a continuous path for the penetration of oxidizing gases and that stability of the carbides by the use of low silicon irons, or alloy additions, is of the highest importance.

Alloys Change Conditions

In contradistinction to processes involving rate of cooling as a principal factor in controlling the disposition of the graphite, are those which, by use of special metals, alloys or chemical graphitizers, aim to eliminate rate of cooling during solidification as an important factor in the process and thereby obviate the disadvantages of altered casting arrangements and the use of hard baked molds. A paper by the author on the value of special metal ladle additions of copper, nickel, aluminum, tungsten, chromium and molybdenum and other metals, in this direction was published in the *Proceedings of the Institute of British Foundrymen*, 1922-23, when consideration also was given to the possibilities of producing malleable cast iron direct from the cupola.

Value of silicides, silicon alloys and alloys having high affinity for oxygen as graphitizing agents has long been established. The best known graphitizers are ferrosilicon, calcium-silicide, titanium-silicide, magnesium, aluminum and zirconium-silicon.

So far as can be traced, calcium-silicide was first used by Wohler and Hans Goldschmidt. Later, Meehan experimented in the manufacture of gray iron castings of superior strength and greater uniformity, by adding silicide of calcium to molten white iron. Physical tests of gray irons so made by Meehan were found by the author to average between 40,000 and 57,000 pounds per square inch tensile strength and with a brinell hardness from 240 to 300.

To ascertain the relative influence of ferrosilicon, calcium-silicide, magnesium-silicon and zirconium-silicon alloys on the hardness, graphitization and tensile strength tests were made on a white iron of the composition, total carbon, 2.6; silicon, 0.90; phosphorus, 0.15; manganese, 0.30, and sulphur, 0.06.

Analysis of Alloys

The composition of the calcium-silicide alloy used was 25 per cent calcium, 55 per cent silicon, 5 per cent iron; the ferrosilicon was 50 per cent silicon; the magnesium-silicon alloy had 12 per cent magnesium, 40 per cent manganese and 40 per cent silicon; and the zirconium-silicide alloy had 35 per cent zirconium, 45 per cent silicon, and 20 per cent iron.

Each alloy was crushed into small pieces less than 0.20-inch and added in the ladle. The method of mixing, the time of standing to allow alloy to mix thoroughly, and the temperature of casting were identical for each test.

All test pieces were cast in green sand molds. Square bars ⅜, ½, ¾, 1, 2 and 3 inches were made to determine mass in its effect on hardness and graphitization. Tensile test bars were cast 0.75-inch in diameter and machined to 0.630-inch in diameter. Brinell tests were made on one face of each of the square test bars after removing 0.03-inch by grinding. Fracture examination was made through the center of each bar.

Before treatment, the iron when cast into bars 3½ x 3½ x 6 inches was white throughout. The results of the ladle additions are detailed in Table I.

One per cent calcium-silicide alloy addition enables the casting of ¾-inch square bars uniformly gray. When less than ¾-inch the bars present white corners and edges and offer machining difficulties. When less than ⅜-inch the bars are white throughout.

With 1 per cent ferrosilicon 2-inch square bars are uniformly gray; 1-inch square bars present white corners and edges, while the ½-inch bar is entirely white.

With 0.50 per cent calcium-silicide in conjunction with 2.5 per cent ferrosilicon, the casting of 0.25-inch square bars of uniformly gray iron was possible.

The use of 0.50 per cent magnesium-silicon alloy in conjunction with 0.25 per cent ferrosilicon did not prove appreciably more effective than the use of 1.0 per cent ferrosilicon.

Using 0.75 per cent zirconium-silicon alloy in conjunction with 0.50 per cent ferrosilicon proved as effective as 1 per cent calcium-silicide.

The term *gray fracture* means that fracture ordinarily accepted by the blast furnace operator and foundryman. However, this inadequately describes the fracture of gray irons. White iron rendered gray by ferrosilicon additions, presents a light colored gray fracture somewhat similar to that obtained from semisteel. Calcium-silicide results in a gray fracture that might be compared with foundry pig iron No. 2; while zirconium-silicide causes a dark gray fracture that might almost be termed black, and which gives the appearance of extraordinary toughness, a property later confirmed by impact tests.

The superior tensile strength of gray iron made from graphitized white iron, Table II, confirms Meehan's findings and sets new standards in tensile strength with suitable machining qualities and demonstrates the potentialities of such irons for high duty purposes. Because of the form of graphite and because of the control of graphitization, eliminating rate of cooling as an important factor, such a process offers advantages over that necessitating the use of hot molds, where uncertain graphitization may result in crystal weakness, machining difficulties and cracking on sudden changes of temperature. Both processes offer the same advantage in resisting growth when subjected to repeated heating and cooling.

Little Progress Made

Where the combined properties of both white and gray irons are required in the same casting, cast iron possibly becomes the most complex and least understood of any metallurgical product. No fundamental advances as yet can be claimed and any progress in the development of superior gray irons for high duty purposes finds little application to either the car wheel or chill roll.

The ability of the cast iron car wheel to withstand severe sudden changes of temperature in service is second only in importance to a hard wearing surface. Due to the complexity of the mold into which the wheels are poured, casting strains are encountered in the car wheel, which render it unsuitable for service. By pitting the wheels at approximately 1650 degrees Fahr. after casting, these strains are relieved or removed.

To determine the efficacy of this annealing process and the ability of the iron to withstand severe changes

of temperature in service, the "thermal test" is applied. This test is made by pouring a ring of molten iron around the chill tread of the wheel. The severity of test varies with different railroad companies' specifications, but commonly if a wheel is found broken in pieces, or if any cracks in the plate extend through or into the rim after pouring a 2-inch section of metal around the wheel, in 2 minutes or under, all wheels of the same tape as the wheel under test are rejected.

The more highly strained the wheel after pitting, the sooner cracking occurs on test, hence any condition conducive to a good thermal test without affecting the service life of the wheel is desirable.

The variation in composition of 1040 wheels that have given average service or better is:

Total carbon	3.0	to 4.10	per cent
Silicon	0.43	to 0.95	per cent
Manganese	0.30	to 0.92	per cent
Phosphorus	0.182	to 0.480	per cent
Sulphur	0.092	to 0.230	per cent

The average chemical analysis of these wheels is: Combined carbon 0.30 per cent, graphite carbon 2.82 per cent, total carbon 3.42 per cent; silicon 0.63 per cent, manganese 0.54 per cent, phosphorus 0.319 per cent and sulphur 0.151 per cent.

The average metal mixtures comprise 80 to 100 per cent old wheels, 0 to 20 per cent pig iron, 9 to 10 per cent steel. For the manufacture of superior wheels, where severe service conditions have to be met, special mixtures are used, including larger quantities of pig iron, or pig iron of superior quality or even charcoal pig iron. This latter is favored where extra severe thermal test is enforced.

Variations of chill are corrected in the ladle, by the addition of steel or ferrosilicon. If the metal is on the soft side, steel scrap is used and ferrosilicon is used when the chill is high. Some car wheel makers introduce small additions of crushed ferromanganese to each car wheel ladle. Why charcoal or superior pig iron should enable a wheel to withstand a severer thermal test and why the all scrap wheel made under the similar conditions should be stronger, have a closer grain and present a lighter colored fracture, but fail more readily under thermal test, is also a matter for conjecture.

In Table III details of four wheels offering exceptional contrast are given. Wheel No. 1 was made to meet an extraordinarily severe thermal test. This wheel was returned after several years of service. On breaking, it presented a dark gray fracture. Wheel No. 4 made in the ordinary way failed badly on thermal test and presented a light gray sparkling fracture on breaking.

The chemical analyses show:

1. That the total carbon and graphite contents are the highest and the combined carbon and sulphur contents lowest in the special wheel.

2. That the total carbon and graphite contents are lowest and the combined carbon and sulphur contents highest in the wheel that failed quickest under thermal test.

3. That there is nothing in the chemical composition of wheel No. 3 to explain its low thermal test.

Physical Examination

Structurally, car wheel iron may be compared with ordinary carbon tool steel. The essential difference is that a car wheel, except at the tread, is interlaced by tiny flakes of graphite which occupy approximately 7 per cent of the total volume, Thus, rapidly cooled car wheel iron presents the same susceptibility to spontaneous cracking on sudden heating as hardened tool steel, while well annealed iron may be subjected to severe thermal stress without cracking.

Because the crystal formation of pearlite is a true indication of the efficacy or otherwise of an annealing process and because its formation can be readily ascertained, we have at our disposal a simple means to not only measure and control the annealing process after casting, but also to study in what way the nature of any combination of irons differ from any other combination, and the effect of different cupola conditions on any particular mixture.

One other essential difference between the microstructure of tool steel and car wheel iron is the presence of phosphide of iron eutectoid (a hard brittle material of low melting point, 1755 degrees Fahr.), which occupies about 3 per cent of the whole volume of the iron. Exerting an embrittling effect on cast iron it renders car wheels more susceptible to cracking under thermal test.

The photomicrographs of Figs. 1 to 4 portray the microstructure of each wheel at a magnification of 200 times. Special wheel, No. 1, photomicograph of Fig. 1 displays a matrix of well marked laminated pearlite, small quantities of phosphide eutectoid uniformly distributed and graphite flakes long, thin and intermingling.

This structure is common to that of soft gray irons designed to withstand sudden changes of temperature without cracking.

Normal wheel, No. 2, photomicrograph of Fig. 2 reveals a matrix of laminated pearlite that does not display so marked a separation of the carbide and ferrite as special wheel No. 1. However, the laminations, are sufficiently well marked as to indicate complete annealing after casting; the form of the graphite flakes is similar to wheel No. 1 except that they are not so long and continuous or present in such large quantities.

The photomicrograph of wheel No. 3, low thermal test, is displayed in Fig. 3. The carbide matrix is sorbitic. Pearlitic formation may be traced, but the quantity present is infinitely small. Another structural difference displayed by this wheel is the short, stubby, inclined to be curly form of the graphite.

The photomicrograph of wheel No. 4, rejected on thermal test, displayed in Fig. 4, shows structural features common to those of wheel No. 3. The carbide is a little more pearlitic although the majority is distinctly sorbitic, while the graphite has the same stubby form.

These four illustrations chosen from a number in an endeavor to correlate the structural disposition of the microconstituents and the physical properties, explain the superior thermal properties of wheels Nos. 1 and 2; show the reason of the dark gray fracture presented by wheels Nos. 1 and 2 and of the cause of the light gray sparkling fractures of wheels Nos. 3 and 4; and explain the superiority of wheels Nos. 3 and 4 under the drop test. Incidently they lightly touch on the vexed problem of the difference between hot and cold blast pig irons; the relation of fracture to chemical composition; the difference between cast iron and semisteel; and finally throw light on the anticipated comparative behavior of high duty irons made from high grade pig rich mixtures and those made from low grade white iron and graphitized, when subjected to rapid heating and cooling in service.

The explanation offered for the superiority of special wheel No. 1, under thermal tests, is that not only was the chemical composition such as to permit a freer deposition of graphite and a free separation of the carbite eutectoid (pearlite), into its component parts cementite and ferrite, but that because of the greater purity of the irons used (rich pig mix) and melting in the first few charges, there was less oxygenation and gaseous contamination than obtained in wheel No. 4, for example, which was cast from the last few tons of a melt (scrap and steel) of over 220 tons, when the cupola was emitting deep brown oxide fumes from the stack.

How and Why in Brass Founding

By Charles Vickers

Presence of Iron Shown

We experience much difficulty when making brass plugs for water pumps, and for the better understanding of our trouble we send you a sample casting. The plugs are just a heavy chunk of brass with a flange and on top a square nut cored out to lighten it. We mold them with the nut in the cope and hang the core in the cope. You will note there is considerable dirt in the casting scattered all over the surface, which we are unable to account for as the molds are clean and we cannot see where it washes from; also the metal is clean, and thoroughly skimmed before pouring. These plugs must withstand a pressure of 2000 pounds per square inch and not sweat through. We would like to know whether the plug is improperly designed for this pressure, as several foundries have tried to make them without success and so far we are unable to get more than 25 per cent of the castings good. The alloy is copper 86 per cent; tin 10 per cent; zinc 2 per cent; and lead 2 per cent. Do you think this mixture is a proper one for the purpose?

The casting is a nice little chunk of bronze being nearly 3 inches in diameter in the body, and 3 inches high, and as far as the design is concerned if the pressure is applied to the square hole in the nut part of the casting, it would be a good move to increase the thickness of these walls to ⅝-inch, either by trimming the core, or by building on the outside of the nut.

The only other thing about the design we criticise is that it is made so nicely with hollows presumably to lighten the casting and so save metal that it becomes a puzzle to know where to gate it and provide egress for the supply of metal to compensate for the natural shrinkage. It is evident that this cannot be done by the method of gating you have been using, as these little gates are simply absurdities on such a casting.

If the patterns were laid on their sides in a match and a parting made at the large part of the round and along the corners of the nut, it would be possible to feed them sound by omitting the core and putting a large gate into the end of the nut; if the hole in the nut is important, then the end of the round part must be made solid and flush, and the gate put into it there.

With a gate of this particular type attached to a heavy feeder, and a sprue small in diameter attached to the feeder, there would not be many castings lost when the metal is poured *on the warm side*. Of course the castings can be made as at present also by cutting a large gate through the flange and into the body, but this is difficult to remove.

Regarding the *dirt* so freely scattered about; no wonder you are unable to find where it comes from, for it is held by the seemingly clean metal itself and calmly flows into the mold, skimmer or no skimmer. This dirt is iron scale, but where it comes from we are unable to state but analysis shows its presence.

Gives Data on Alloys

Kindly give us some information about sterlite and monel metal, particularly the melting points.

Sterlite is a modified nickel-copper alloy frequently used for casting automobile hub caps and contains up to 30 per cent nickel, about 15 per cent of zinc, with 8 per cent lead and 1 per cent aluminum, as well as a little tin and iron. We will hazard a guess that its melting point will be around 2100 degrees Fahr., or a little under so that its melting in ordinary brass melting furnaces will present no special difficulty. The melting point of monel metal is 2480 degrees Fahr.

The specific gravity of the metal as cast is 8.87; tensile strength as cast, around 75,000 pounds per square inch and elongation about 30 per cent in 2 inches. Its scleroscope hardness is 20 and brinell hardness is 100. As its melting point is well up it is seldom handled satisfactorily in coke-fired, pit-type furnaces. A rapid melting oil-fired or gas-fired furnace being best. No especial difficulty need be anticipated about making monel metal castings provided crucible furnaces are at hand that will quickly reach the high temperatures necessary for melting and superheating the metal.

Wants Monel Metal Data

We would like to obtain a little information about monel metal; Of what does it consist? What is its melting point? Is it hard to run? Is there any other alloy that can be used for washing machine castings that will not rust or verdegris from the use of soda and acid?

Monel metal is an alloy of nickel, copper, iron, manganese; usually 67 per cent nickel; 28 per cent copper; wtih 5 per cent iron, manganese and silicon. The United States navy specifications are copper 36 per cent; nickel 60 per cent; iron 3.50 per cent, and aluminum 0.50 per cent. Aluminum is added to assist in making castings, as it increases the fluidity of the alloy.

Melting point of monel metal is 2480 degrees Fahr. Therefore, it is not advisable to attempt to melt the alloy in a pit-type, coke-fired crucible furnace. It should be melted in oil-fired or gas-fired furnaces, because the quicker it is melted and brought to casting temperature, the better.

Is it hard to run? Yes, some foundrymen find it so, others have *good luck* with it, but one must understand that good luck in foundry operations means the use of brains and common sense, and naturally the person must also be skilled in nonferrous metal founding.

The first thing to consider is the high melting point. This means a high temperature furnace is required to melt the alloy. Molding sand must be of a more refractory nature than for red brass, otherwise it will fuse on the casting, and when the scale is removed leave holes underneath.

In making washing machine castings the alloy containing aluminum can be used as it will flow better, than without it, also will not "burn" into the sand as otherwise, but for pressure castings there must be no aluminum in the alloy. Aluminum, although making the metal more fluid, does not give a metal sufficiently dense for pressure castings. An ordinary red metal ought to be satisfactory for washing machine castings, such, as copper 85 per cent; tin 5 per cent; zinc 5 per cent; lead 5 per cent.

Bill Melts Copper in an Air Furnace

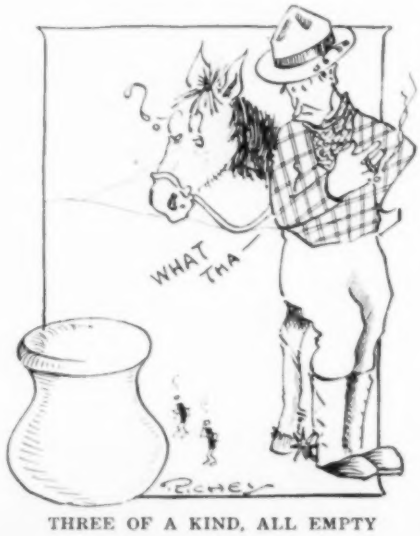
By Pat Dwyer

QUEER things drift in occasionally in the day's mail. Letters from people I know or have known, letters from people I don't know, but whose acquaintance I am glad to make even at long distance. 'Tis a pleasure to acknowledge receipt of these communications. Now and again I get one from a citizen nursing a grievance, real or imaginary and if it is not too violent I hasten to extend the olive branch. Misunderstandings arise in the best regulated families, but through long experience I have found that the average citizen is amenable to the truth of the old saying about a gentle answer. However, the foregoing does not necessarily mean that if I am slapped on one cheek, I turn the other with meek and Christian resignation. One cheek absolutely is the limit.

The preceding paragraph, merely is a digression. What I had in mind particularly when I stepped on the starter and threw in the clutch on this trusty little machine is the flock of material know under the generic title of direct mail advertising which floats into my den periodically from no one knows where. While refusing to commit myself, I am willing to admit, merely for the sake of argument, that this is a free country. If people wish to waste their money trying to sell me books, life insurance, real estate, stocks and bonds, furniture, clothing, membership in exclusive associations, health courses, automobiles, fresh eggs, prunes or pollywogs for the aquarium, that is their privilege.

Fortunately I have a large, generous, open mouthed waste basket convenient to my elbow and if I enjoy a momentary pleasure in shooting the various communications unopened and unread into its capacious maw, surely no person will deny that is my privilege. In sporting parlance the arrangement is a perfect split 50-50. Occasionally idle curiosity causes me to wonder how my name came to be entered on the mailing list of these various individuals, firms or associations. More occasionally still when I have nothing to do the same idle curiosity prompts me to glance carelessly at some of the literature. So far as I can remember I never have signed on the dotted line or ordered any of the goods advertised in this manner, but now and again the perusal has started a train of thought which helped to pass away a few idle minutes.

Yesterday I received a little pamphlet containing among other items of more or less interest a picture of a large copper pot apparently about three feet in diameter and almost the same height. A noble pot any way you want to look at it. The text accompanying the illustration stated that this pot filled with liquor occupied a prominent place for many years in a saloon during the red roaring days of Virginia City, Nev. Later when the glory of this most spectacular of all mining towns of the West had departed, the copper vessel had sojourned for varying periods in other mushroom camps and finally landed in Ely, Nev., where gradually it had sunk from its former high estate and deteriorated into a common watering trough for horses. A horrible example, or a shining tribute, depending on the point of view, of the eighteenth amendment to the constitution of these United States.



THREE OF A KIND, ALL EMPTY

Recently a prominent mining engineer rescued it, the pot, not the constitution from oblivion and carried it away to his palatial home in California where he had it mounted on a pedestal made from lumps of copper ore. The ore came from deposits from nearly all over the world in which this engineer had a finger in the pie at one time or another in a variegated career extending over many years. Serene and beautiful, probably it will last forever an eloquent tribute to the noble red metal and to the skill of the master hand who fashioned it, unless some vandal sneaks it away some night in the dark of the moon and melts it down for scrap. Sentiment has little place in the life of a junk man. A pot is only a pot, but a sizeable hunk of copper is an appreciated and negotiable asset.

So far as the story went it presented several points of interest, but to me the most essential features were omitted. For example who made the pot, where was it made and most important of all how did it come to Virginia City up in the mountains of Nevada. Manifestly it did not walk or roll up there by itself. Pots have been responsible for a good bit of rolling of one kind or another, but I never have seen, heard or read of one, full or empty that rolled by itself.

Run them over in your mind. Call the roll. You heard of rolls-royce, roll your own, rolled stockings, roll the old chariot along, Parker House rolls, actor's roles, rolling pins, rolling down to Rio, road rollers, roll the bones, high rollers, roll on thou deep and dark blue ocean, holy rollers, rolling home, rolypoly and I'm so shy darling roll up the blind, but you never heard of a rolling pot. Furthermore, with the primitive manufactur-

ing conditions prevailing in the far western mountain states at the time the pot first rolled into view, it is evident that it was not made in that territory.

Now that we have a few minutes, dear children, before dismissing the class for the day let us examine briefly the many possible routes by which this noble bowl, the center piece of many a wild carousing night, arrived at its destination. Let us approach the subject in a calm, dispassionate manner. Those who hold to the view that the only point worthy of consideration is that the pot finally arrived, kindly will take seats in the rear and pipe down. Do I make myself clear? According to the rules laid down by the late Mr. Carter (Nick, not the liver pill guy) in his monumental work *Wild and Wooly Ginks I Have Trailed To Their Lair*, the proper method of solving a mystery is (a) begin at the beginning, (b) suspect every person, (c) eliminate them one by one, (d) finally clap the black spot on the village blacksmith who shot the bull under the chestnut tree. The method, you will observe, is direct, orderly, logical, positive and most important of all never fails.

In a broad general way we may assume that the pot did not grow over night like an inverted toadstool. The suggestion that it was discarded by a bathing beauty from an early Follies show is equally untenable. Wild, irresponsible, lawless men of the mining camps and the old frontier were not sufficiently sophisticated to appreciate this delicate form of entertainment. Civilization has made vast strides in the past 50 years.

After having cleared away the foundation of the case with cold, pitiless logic, let us see what methods of transportation were available in these early days. Methods by which a huge copper caldron could be carried from one side of the North American continent to the other side. The objection that no person knows where the pot was made, is entirely irrelevant and has no bearing on the main point at issue. For the benefit of the geographical dummies in the back row I might state that Pottstown, Pottsville and another town whose name escapes me for the moment are in one of the eastern states. These elementary explanations should not be necessary.

The vessel filled with corn meal or hardtack and with a tarpaulin stretched across the top to serve as a bed for the baby, may have been carried over the plains in a covered wagon. Several plausible reasons may be advanced in support of this theory. The most convincing readily will come to the minds of those who are old enough to remember that sterling old play which portrayed the consequences of indulging to excess in strong drink.

Editor's note: During the period of which the author writes, B. V. 1880, this invigorating beverage was known as booze or suds.)

(Author's note. So was your old man.)

In this sterling drama of Hearth and Home you may remember that the cruel and unnatural father, carried away by the insatiable craving for the despicable stuff that stingeth like a serpent and biteth like an adder, sold everything he had to—I believe the term is *raise the wind*—and finally hocked the kid's shoes for a slug of gin. You will note that the demoralizing atmosphere of the day was reflected even in the language.

RING-A-ROSY! BLESS THEIR DEAR LITTLE HEARTS

What is more natural than to assume that the original owner of the famous copper pot pursued a similar course. Parched and sun dried after the long weary journey across the blazing plains, with his tongue hanging out and with the bones rattling inside his skin, he may be pardoned if he listened to the siren voice of the tempter, the gent with the white apron and the voluminous moustache, who offered to put him on the liquid route to paradise in exchange for the baby's cradle.

However, while the foregoing hypothesis seems to be as air tight, copper riveted and puncture proof as the pot itself, conclusions should not be drawn too hastily. Several minor points still remain veiled in obscurity. For example where are the finger prints of the baby and the father? No case ever was completed without finger prints. The pot bears many smudges and scratches but no microscope is needed to show that these were made by the nails and hairy paws of red shirted revelers trying to maintain a balance while shouting "Fill 'er up again!"

Fortunately I had an opportunity to consult Bill before I arrived at a definite solution. I laid all the cards frankly on the table and in hearty man to man fashion stated my views with a full and detailed description of the various factors, clues, hints, gossip, trifles apparently light as air but momentous and full of portent to the trained observer, which had influenced my decision. I was surprised to find that Bill's view differed from mine.

"Well," said Bill "I think you are all wet. That pot never traveled the overland route. It was built originally to cook the grub for a deep sea crew and was installed in the galley of one of the big racing clippers that reeled off the long sea miles between Boston, New York, Baltimore and San Francisco in the days when the American merchant marine was a synonym for speed and beauty. I don't know for certain how the pot found its way up to Virginia City, but it is a matter of record that lure of the gold fields caused every crew to desert in San Francisco. No great stretch of the imagination is required to visualize one of these harum scarum gangs grabbing the big pot and carrying it away as a souvenir. A pie eyed bunch of wastrels, they grabbed while the grabbing was good and nothing but the weight of things prevented them in some instances from dragging away the main mast and the anchors.

"On the other hand, as you might say, a possibility exists that tender recollections clustering around the old galley pot influenced their actions. Memories of wild and stormy days and nights invariably were associated with the hot and savory meals served up from the old kettle. The bubbling contents spelled heaven on many occasions to the weary watch coming down from the yards where the canvas was frozen as hard as iron. Frozen stiff, drenched with spray and in constant danger of being washed overboard in the cascades of angry green water that poured over the bows, these hardy lads fought and clawed their vessel ever westward past the lonely and God forsaken tip of the South American continent. In these stirring days the old copper pot played a yeoman's part. It was a veritable rock in a weary land, a

shelter in a time of storm. Small wonder that in happier days and in a more favored clime these tough old argonauts with undoubted hearts of gold in their hairy chests, should want to take it with them."

"Your theory," I said "Does credit to your imagination, but unfortunately it presents one serious, I may say, fatal defect. If the pot had been filled with rum I am willing to grant that the crew carried it away, but an empty pot—No, no, my lad. You are—what is the word?—wringing wet."

"Well," said Bill "I'll tell you. The pot may not have been filled with the red rum of Demarara, although this also is a debatable point, when it left San Francisco, but according to all available reports it was filled and emptied on innumerable occasions after it arrived at its destination.

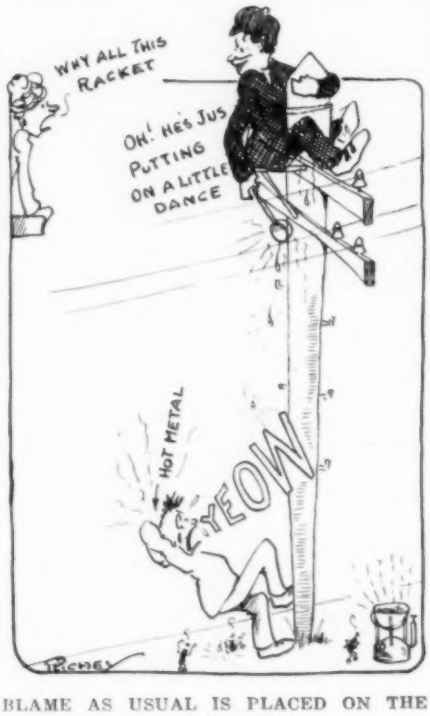
"I am surprised to find you skipped several stages in the history of this interesting old relic. When the glory of the Comstock lode departed about 1885 the pot departed also and flourished for some years in Pete Newman's brewery in Cherry Creek. Then it went to Ely and slowly descended to the position of a watering trough in a livery stable. Civic pride eventually prompted its removal to a rock pedestal at the north end of Main street and East Ely near the depot of the Nevada Northern railway. Here, polished and shining, filled with flowers, a land mark for tourists it served for many years as an emblem of one of the greatest copper camps in the United States.

"It was there the last time I came through that way and your story is the first intimation I have had that once more it has come down out of the mountains and now is reposing peacefully on a gentleman's lawn. Your suspicion that some guy probably will pinch it and sell it for junk opens a new field for speculation. The ultimate purchaser who tries to melt it will find that it is an awkward handful.

Reminds me of an experience I had one time many years ago in a steel plant where the production of 20 to 30 copper tuyeres for the blast furnaces formed part of the regular daily routine in the foundry department. At first the metal was melted in a battery of four coke fired crucible furnaces, but as the demand for a miscellaneous line of brass and bronze castings increased, some other medium for melting the tuyere metal had to be devised.

"The master mechanic decided on a small reverberatory furnace and in spite of all the wise head shaking on the part of the foundry staff, who if the truth must be told, were more familiar with iron than nonferrous melting practice, he persisted in his views and had one built. He was warned that the metal probably would not melt at a sufficiently high temperature to insure the necessary fluidity to pour these thin and tricky castings. If the required temperature was attained the metal would be burned and oxidized.

"This young master mechanic modestly admitted he never had seen the method tried. He was not a foundryman. He came originally from the



BLAME AS USUAL IS PLACED ON THE MAN HIGHER UP

north of Ireland, but he had been mixed up with steel mill construction and operation on this side for several years. This is a man's game which usually sharpens the wits and increases the working vocabulary to a remarkable extent. Probably he was endowed at birth with a natural gift along this line, but as he grew up he had cultivated it assiduously in the particularly favorable environment of the steel mills. At the time I had the pleasure of his acquaintance he had a wider range and a nicer discrimination in the use of picturesque and profane invective than any man I met before or since. In a word, he was good. When all the ordinary words and combinations were exhausted he invented new ones.

"On this occasion he set a new high record in r. p. m. Boiled down to their essentials or in other words after running his remarks through an imaginary gear reduction train, they amounted to this: He would get a high enough temperature in the furnace if he had to build a stack as high as the Ram o' Darby's horns. If the metal was burned he would take the blame. That was the kind of a little guy he was.

"He built the furnace with a soft coal fireplace at one end and a stack 40 feet high at the opposite end. Old tuyeres were charged whole instead of having to be broken in small pieces as was customary and necessary under the former regime and the resulting metal was more satisfactory than metal melted in the crucibles. The furnace was in use for 20 years and only was abandoned eventually when a new master mechanic cut down the consumption of tuyeres to three or four a day.

"Profanity," said Bill "appears to be dying out among the working classes. I heard a story the other day of an old maid who complained about the language of two electrical workers who were doing some cable repairing in the vicinity of her house. The manager investigated and received the following truthful report from the foreman: 'Me and Bill Fairweather was on this job. I was up the pole and accidentally let the hot lead fall on Bill. It went down his neck. Then he said, 'You really must be more careful Harry!' "

Remove Office to Plant

Royersford Foundry & Machine Co. Inc., Royersford, Pa., has removed its general sales office from Philadelphia to the plant at Royersford. The office at Philadelphia will be retained as a city sales office in charge of H. S. Wiegand. E. H. Neely has been appointed salesman for greater New York and the New England States. J. J. Dunphy will cover New York, Pennsylvania and Maryland. Harry A. Lyon, formerly with the Bock Bearing Co., Canton, O., will cover the states adjoining west of Mr. Duphy's territory.

Equipment Makers Meet

Discussion of pricing for profit, led by W. L. Churchill, consulting engineer, White Plains, N. Y., featured the meeting of the Foundry Equipment Manufacturers' association, held at Atlantic City, N. J., Nov. 16. Mr. Churchill maintained that few manufacturers have the definite idea of profits necessary for success. The meeting was held jointly with the Foundry Supply Manufacturers' association. Members' reports showed business 17 per cent above last year. The next meeting of the association will be held at the Cleveland hotel, Cleveland, on Feb. 1.

SHOW WELDING PROGRESS

American Welding Society Holds Annual Convention and Exhibit at Buffalo—Stress Work of Universities in Teaching Welding Theory

EVIDENCE that welding processes have reached major importance in American industry permeated all sessions of the American Welding society which conducted its sixth fall meeting at the Broadway auditorium, Buffalo, Nov. 16-19. Attendance at meetings exceeded 200 and constituted a record. Progress and economies of the electric, gas and thermit methods of joining metals together were ably discussed in the numerous technical papers, but final emphasis on achievements was secured through the most complete exposition of welded products and demonstrations of welding and cutting equipment.

America leads the world industrially because of ability to organize and its close employer-employe relations, acording to G. C. Lehmann, general manager, Buffalo chamber of commerce, who at the opening session on Wednesday morning welcomed the American Welding society to Buffalo.

Welding and its application to the railroads was the subject of the technical session on Thursday morning, at which A. G. Oehler, associate editor, *Railway Age*, presided as chairman. In an illustrated paper on this subject, G. H. Gjersten, master welder, Northern Pacific railway outlined the most common applications of fusion welding in the construction and maintenance of locomotives and suggested the best methods to be employed. To determine the success and economy of the various applications, the speaker urged that careful and complete records be kept. Failures of welds must be made known to those who performed the work.

In a more extensive paper on the same subject, F. H. Williams, assistant test engineer, Canadian National railways, discussed in detail the training of operators, inspection and testing, selection of material, design of parts, organization of supervisory force, standard instructions, control of method and procedure, check on service results and economies. The speaker said that actual figures on economies would be hard to obtain, but even under the most unfavorable conditions, welding is a great economic factor in both time and money. A number of lantern slides illustrated typical uses of welding in the railroad shop.

Universities are performing a distinct service to the welding industry through courses of instruction in welding theory and practice. This fact was brought out forcibly by several speakers at the session on Thursday morning, with Prof. C. A. Adams, Harvard university, Cambridge, Mass., as chairman. Prof. S. T. Hart, Syracuse university; Prof. R. D. Rickley, Ohio State university, Columbus, O.; and Prof. F. V. Larkin, Lehigh university Bethlehem, Pa., presented brief papers on this subject. In addition, papers prepared by Prof. W. P. Turner, Purdue university, West Lafayette, Ind., and Prof. E. L. Lucas, Mississippi Agricultural and Mechanical college were read before the meeting.

This session on welding education, the first conducted by the society clearly demonstrated that colleges and universities are doing more for the welding industry than has been understood generally on the outside. The papers presented pointed out that it is not the intention of technical schools to turn out expert welders, consequently practical weld making is limited. The purpose is to acquaint students with the various forms of welding, the theory involved and the applications of each form in industry.

Actual training of welders for production work properly should be the function of trade schools. According to the college representatives, present instruction is largely confined to lectures and acquainting students with types of equipment.

All speakers who discussed the various papers expressed surprise at the extent to which welding education has been provided, inasmuch as a few years ago engineering courses provided no such instruction, graduates now being turned out with a good idea of fundamentals in the processes. Professor Adams urged the society undertake standardization of welding terms and provide definitions in order that a better working knowledge be obtained.

James W. Owens, director of welding, Newport News Shipbuilding & Dry Dock Co., Newport News, Va., presented a written discussion of welding education in which he outlined in detail what instruction should include and suggested subjects for lectures. In addition, he distributed in blueprint form a diagram of welding as a method of joining metals and their interrelation. Another speaker on the same subject urged that colleges provide more instruction in the design of welded joints, this applying particularly to the civil and structural engineering departments. Likewise, more extensive research would be desirable.

Consider Acetylene Welding Problems

DURING the past few years, considerable clamor has come from certain sources that the time can be reckoned when the world's reresources of petroleum, coal and other organic compounds will approach exhaustion. Possibility of exhaustion, however, has been postponed successfully by the introduction of synthesized materials, and the one and only bridge between inorganic and organic products today lies in acetylene and its by-products. This was the statement made by Dr. Gerald Wendt, director of industrial research, Pennsylvania State college, State College, Pa., at the opening meeting of the twenty-seventh convention of the International Acetylene association, at the Congress hotel, Chicago, Nov. 10-12.

At this convention, declared the most promising held since organization of the society, some dozen paper were presented depicting the rapid progress made by the industry in recent years in developing applications for efficient oxyacetylene welding.

"Welding of any nature is seemingly an unavoidable evil in the steel foundry, and is used merely as a means to an end, to overcome defects not eliminated otherwise." With this statement, L. E. Everett, Nugent Steel

Casting Co., Chicago, went on to describe the factors considered by his company in the "Selection of a Welding Process." Mr. Everett also described circumstance governing the choice of either the bare metallic electrode process, the carbon electrode process or the oxyacetylene process for performing the job at hand, and considered the relative merits of each for steel founding practice.

The Nugent company, it appeared, employs the oxyacetylene weld, as in the case of leaks in pressure fittings, for areas subjected to close machining, and where a ductile weld is needed. In certain manufacturing processes also, the author stated, the oxyacetylene torch is employed economically and satisfactorily. Burning out casting defects with the oxyacetylene torch was recommended over the chipping-out process, by J. J. Crow, in discussing Mr. Everett's paper.

An analysis of various tensile and laboratory welding tests, with special emphasis laid on nondestructive tests, was offered by Dr. H. L. Whittemore, bureau of standard, Washington, in his paper on "Testing of Welds." Of the three most promising nondestructive tests, namely; electrical resistance, magnetic analysis and the X-ray method, Dr. Whittemore asserted that the latter test affords considerable possibilities in the examination of welds not to exceed two or three inches thick. The magnetic method, it was pointed out, has all the requisites of simplicity, cheapness, rapidity and availability, but seems best suited to examination of long cross sections such as rails or gun barrels.

The author also urged that proper study be made of pratice variation, of the effect on the weld of distance and angle of torch tip, and of the fatigue resistance of the weld.

A number of members discussed this paper, including S. W. Miller, Union Carbide & Carbon Research laboratories, Long Island City, N. Y., who declared that a competent welder can weld uniformly under any circumtances. He also stated that tensile tests on welded cast steel give a yield point of about 35,000 pounds per square inch for the base metal and about 40,000 pounds for the weld metal, and that under alternating stress tests have shown the rupture of welded mild steel usually occurs at practically the same point as the unwelded steel.

Dr. A. Krebs, in discussing "A Few Factors to be Considered for Accelerated Progress of the Gas Welding Industry," offered a paper which was read by S. W. Miller. The author urged particularly that general, fundamental laws governing the flow of gases be translated into specific, practical data applicable to torch use.

A. Cressy Morrison, Union Carbide Co., New York, discussing Dr. Krebs' statements, declared that selection and use of any welding rod should be governed by the necessity of obtaining one having such elements as will prevent, under melting temperatures, the loss of desirable elements in the weld.

Another paper at the Thursday afternoon session considered "The Most Important Thing in Welding," the author, S. W. Miller, stating that this factor is neither design, materials, operator, supervision nor tests, but the maintenance of proper procedure control.

One of the most valuable papers of the convention was presented at the Friday morning session, Nov. 12, by E. E. Thum.

"Heat treatment by the Oxyacetylene Flame." was the subject of a paper by E. E. Thum, in which he detailed a number of specific examples wherein the oxyacetylene torch has been applied to heat treatment of steel.

W. C. Swift, American Brass Co., Waterbury, Conn., in his paper on "Some Applications of Bronze Welding," pointed out numerous examples where bronze welding has been applied successfully to work on steam lines, pipe lines, electric telegraph lines, farm machinery, locomotive cranes and locomotive frame welding. The largest field of bronze welding, he said, is in the repairing of broken cast iron parts. A third paper scheduled for the Friday morning session, dealt with "Production Welding on Steel Furniture," by M. F. Bayer, Simmons Co., Kenosha, Wis. "Underwater Metal Cutting," prepared by L. F. Hagglund, Underwater Metal Corp., New York, was the subject of another paper, at the afternoon session.

Book Review

Engineering Metallurgy, by Stoughton and Allison Butts, 441 pages, cloth, 5½ x 9 inches, published by McGraw-Hill Book Co. Inc., New York, and supplied by THE FOUNDRY, Cleveland, for $4.00 and in London, 2-3 Caxton House, Westminster S.W.1, for 20s.

While this book was written primarily as a text for students in the branches of engineering which are concerned more with the use of than with the production of metals, users of metals in the industrial field will profit by a study of its pages. The metallurgical industry is closely allied to and bound up in other industries, and is of such magnitude and importance that it cannot be dealt with completely in any one book. However, this volume will serve well as an introduction to the study of metallurgy. The more important phases are covered, and will give the reader an excellent idea of the production, the uses, and the testing of metals. Corrosion and its prevention, fuels and combustion, pyrometry and heat transfer and losses in industrial furnaces also are covered. For those desiring to study further into this fascinating subject of metallurgy, a bibliography is given at the end of each chapter. Many illustrations and diagrams aid in visualizing the subject matter.

Hold November Meeting

At the meeting of the New England Foundrymen's association held in Boston on Nov. 10, R. W. Adams, manager, Providence, R. I., office of the General Electric Co., stated that a correct organization is of more importance than a correct mechanical manufacturing plant. Psyschology and intelligence tests have been over emphasized and common sense has been overlooked in placing new men in industry, according to Mr. Adams. He also pointed out that recent scientific investigations tend to prove that there is no relation between physical characteristics and mental characteristics. Certain physical characteristics may be and frequently are desired but they have no bearing on the mental qualifications. In judging a man Mr. Adams said that is important to consider four general subjects, namely; Intelligence; energy and enthusiasm; co-operativeness, and morality. Under the latter head is placed integrity, honesty, loyalty and other general characteristics.

Following this talk, Harry D. Neach, Sherman Corp., Boston, spoke on "What Is Wrong with the Foundry Industry." He said that one of the chief difficulties is the menace of the shop which is a department of a large manufacturing plant. Such a departmental foundry enters the jobbing foundry trade under conditions which are unfair to the established jobbing foundries. About 100 foundrymen were present at the meeting.

Link-Belt Co., Chicago, has established temporary headquarters at 152 Temple street, New Haven, Conn. R. H. Hagner, formerly of the Philadelphia office will be the firm's representative.

Burner Selection Involves Study of Entire Heating Problem

WHEN the operator of an oil-fired industrial furnace says he is having trouble with the burner, it is well to look at the entire installation. His problem may appear to be one of "burners," but the chances are that it is really one of heating, cooling and handling material, and of providing comfortable working conditions for the operatives under specific conditions.

It is the design and method of operating the furnace—not the burner—that invariably determines the final result. Unless the furnace is properly designed to provide and maintain uniform application of heat to the charge; efficient utilization of heat within the furnace; accurate control of temperature, furnace atmosphere, spent gases and fuel consumption; efficient handling of material to be heated; and comfortable working conditions for the operatives, the application of any type of burner is of doubtful value. Burner equipment should be selected to harmonize with these essential conditions rather than to suit existing furnace conditions, which may, or may not, be suitable for production of a quality product at low cost.

Knowledge of Design Essential

As a rule it is impracticable to select burners without full knowledge of the furnace construction and operating requirements in order to determine the number, position, size and arrangement of the combustion chambers that are essential for their proper application, particularly with fuel oil. The common practice of applying oil burners to furnaces without regard to the fundamental conditions governing the heating operation as a whole represents an unwarranted source of waste and is responsible for most of the prevailing inefficient methods of using fuel oil in industrial heating operations. It is a rare fuel oil installation that does not permit of better heating methods, fuel economy and improved working conditions for the operatives by suitable alteration of the furnace structure without a change of burners. Unsatisfactory results are usually attributed to the fuel or the "burner" when, as a matter of fact, the design or method of operating the furnace is usually the source of the difficulty.

Oil burners do not "burn oil" in the sense that gas is burned, as ordinarily applied to industrial furnaces. The oil itself does not burn. It is oil, gas and air in the form of a combustible mixture that really burns and converts the energy in the fuel to heat.

The combustion chamber is the real "oil burner" or "gasifier" in which the combustible mixture is formed, ignited and transformed into heat. The combustion chamber must be properly located and designed with provision to control the supply of fuel and all the air; to maintain uniform combustion with variable flow of fuel and air; and to distribute the products of combustion without direct blast or other injury to the charge.

Inasmuch as oil must first be converted into gas and the gas mixed with air to form a combustible mixture, it is apparent that an oil fired-furnace is, in reality, the combination of a gas producer, represented by the combustion chamber and the "burner," and means for the application and utilization of heat, represented by the heating section of the furnace structure. In this respect an oil furnace differs from a gas furnace with corresponding difference in the form and number of burners, and the number, position, size and shape of combustion chambers in the installation.

The real efficiency of an oil burner is mainly mechanical, as with any other type of spraying, mixing or injecting valve. It may assist in the heating operation by preparing the oil for gasification by atomization or otherwise; and as a means for injecting and regulating the supply of oil and air beyond this the burner is relatively unimportant, except in operations where the form of the blast or flame, is a controlling factor.

The supply of fuel and air varies with the nature of the heating requirements, the furnace design and the method of operation. The burner bears about the same relation to the operation of the furnace that the spray valve of a carbureter does to the operation of an automobile. In fact, a burner cannot properly be considered the equivalent of a carbureter unless it handles fuel in the form of gas or vapor and is arranged to automatically vary the supply of air with the supply of fuel, a condition rarely found in industrial heating operations.

Various Factors Influence Cost

A burner, like a carbureter, is but a means to an end. The combustion of fuel, or the generation of heat, is but one phase of the operation as a whole. The quality and cost of the finished product is the determinative test in industrial heating operations just as the over all cost per ton mile may be considered the test in the operation of a motor truck. Loss from poor combustion of liquid or gaseous fuels in the average industrial furnace is relatively small, although loss from poor application or utilization of the resultant heat is usually great. Better furnaces and better methods of handling them must be provided to produce better and cheaper operating results through more efficient use of heat energy.

These points are so simple and fundamental, and have been conclusively demonstrated so often in practice, that it is difficult to reconcile the prevalent notions relative to the function of oil burners with the facts governing the conduct of industrial heating operation. This illogical situation may be explained by the tendency of the average man to think in terms of combustion or

Results Best Test of Heating Efficiency

WHILE an effort is made in the accompanying article to indicate briefly the conditions governing selection and application of suitable burners, it should be remembered that the real question involved is not alone one of burner selection, but, rather, the successful conduct of a heating operation, the results of which should be measured by the quality and overall cost of the heated product. Improper furnace layout is inefficient and consequently expensive.

The article is abstracted from a booklet on oil and gas burners published by the W. S. Rockwell Co., 50 Church street, New York, and is published by permission of that company.

heat generation, and to overlook the fundamental factors governing the efficient application of heat to the product and the utilization of heat within the furnace.

The common-sense principles effecting the design and operation of the ordinary household heater could well be substituted for much of the prevailing inefficient industrial heating practice with advantage to the manufacturer in the form of better and cheaper products, decreased fuel bills and the advantages that accompany improved working conditions for the operatives with modern heating equipment. In either case the problem is really one of the efficient application and utilization of heat with the selection of suitable form of furnace and burner as a means of this end.

Officers Are Elected

Re-election of last year's officers and 35 directors, the election of seven new members to the governing board and a report of the council for the last year, featured a meeting of the Safety Council of Western Pennsylvania held in the chamber of commerce auditorium at Pittsburgh Nov. 17. John A. Oartel, safety director, Carnegie Steel Co., was renamed president; W. H. Boyce, Pittsburgh railways and Earl F. Blank, Jones & Laughlin Steel Corp., vice presidents, and D. F. Crawford, Locomotive Stoker Co., secretary-treasurer. The new directors are: Frank J. Lanahan, president, Fort Pitt Malleable Iron Co.; James M. Clark, director of public safety; C. J. Cullen, Duquesne Steel Foundry Co.; T. N. Hazlett, Duquesne Light Co.; W. E. Megraw, H. H. Robertson Co.; B. W. Lemmon, president, Automobile Dealers' association; Richard L. Smith, fire chief, and Jack Campbell, Union Switch & Signal Co. Mr. Lanahan takes the place formerly occupied by his brother, J. S. Lanahan. George E. Clarkson, manager of the council, read the report of the activities of the body during the last year.

Gases Affect Soundness

(*Concluded from Page* 945)

in cores although ample in the first place are very often seriously reduced in area when the molder is providing a passage for the core vent through the mold. Coremakers should be instructed to allow passages of good size and see that all vent passages are connected to the outside vent pipe.

Small thin cores are vented by forming a simple passage through the center. Medium sized cores may be vented by a main passage augmented by holes made with the vent wire either outward from the passage or by thrusting the vent wire in the direction of the main passage before extracting the main vent rod. Large cores are vented by cinders and holes formed by the vent wire and connected to large open vents through the urints.

The gases from the loam cores pass from the face to the straw wrapping and then through perforations in the core barrel. Other loam cores are vented in the same manner as with ordinary sand. Wax wire vents also are used advantageously in all grades of sand except oil sand. The venting in oil-sand cores often is neglected, as both coremaker and molder trust too much to the excellent free venting nature of this type of core.

From the group of drawings, Figs. 1 to 10, illustrating certain sections commonly experienced with defects which are usually explained as liquid shrinkage holes or cavities, the author suggests that they are, in every case, with gray iron, gas defects.

Fig. 1 shows a section of a heavy half flywheel. Tee-shaped holes are formed in the rim by cores. Sponginess occuring at the nose of the core, in spite of heavy rod feeding, was eliminated when a free core vent was provided.

Gear blanks similar in design to Fig. 2 give trouble where the arm meets the rim. Gases play off the hot corners of the core. Denseners placed in the cores, as shown in the enlarged section is a remedy. Fig. 4 illustrates a section which also gives trouble. Gases play into the hot spot formed where the bracket meets the body. Holes formed through the bracket, preferably by an iron core, as described, will prove effective.

Figs 5 and 6 show defects in small rams and heavy hydraulic cylinder castings. Denseners attached to the nose of the cores are employed. If gases are conducted freely away, and the core carefully made, the denseners are not needed. Fig. 7 is another common defect. Cavity is disclosed when the recess is cleaned up by machining. Figs. 8, 9 and 10 can all be explained in a like manner which the author attributes to gas defects rather than other causes.

United States Cast Iron Pipe & Foundry Co., New York, has complete arrangements whereby it has acquired the rights for Central America and Mexico of manufacturing cast iron pipe by the centrifugal process of DeLavaud.

Testing Material Society Will Meet in Indiana

American Society for Testing Materials will hold its 1927 meetings at French Lick, Ind., from June 20 to 24. This will be the first time that the organization has met in the Middle West. The 1927 meeting marks the twenty-fifth anniversary of the incorporation of the society and plans are being made to commemorate the event.

In line with the idea of greater dissemination of the society's work a new grade of membership has been established. This is called student membership and is open to a junior, senior or graduate student in a technical school of recognized standing, or a student not over 25 years of age engaged in technical studies in an apprentice course or night school.

The committee on the 1927 Marburg lecture is comprised of W. H. Fulweiler, United Gas Improvement Co., Philadelphia; T. G. Delbridge, Atlantic Refining Co., Philadelphia, and F. E. Schmitt, *Engineering News-Record*, New York. Dudley medal award committee is composed of M. E. McDonnell, Pennsylvania railroad, Altoona, Pa., chairman; William Campbell, Columbia university, New York, and A. T. Goldbeck, National Crushed Stone association, Washington. The membership of the American Society for Testing Materials now is 4145.

Refractory Oxides Studied

The suitability of commercial refractory oxides for melting pure iron and pure nickel in the arsem furnace recently has been studied by the bureau of standards. Most of the commercial, electrically-sintered magnesia was found to introduce sulphur into the pure metals. Commercial fused zirconia and aluminum contaminate the melts with silicon. A chemically pure grade of magnesia, calcined at 1600 degrees Cent. and bonded with shellac and alcohol or with a solution of magnesium chloride was found to be the most suitable refractory.

Pure platinum and platinum-rhodium alloys were melted satisfactorily in high frequency electric furnaces using commercial, electrically-sintered zirconia as the refractory. This material is purified by an acid washing to remove iron and by roasting to remove carbon and carbides. Cast zirconia crucibles fired at 1700 to 1800 degrees Cent. are suitable for melting platinum, rhodium and other platinum alloys.

Lathe Pattern Is Adjustable

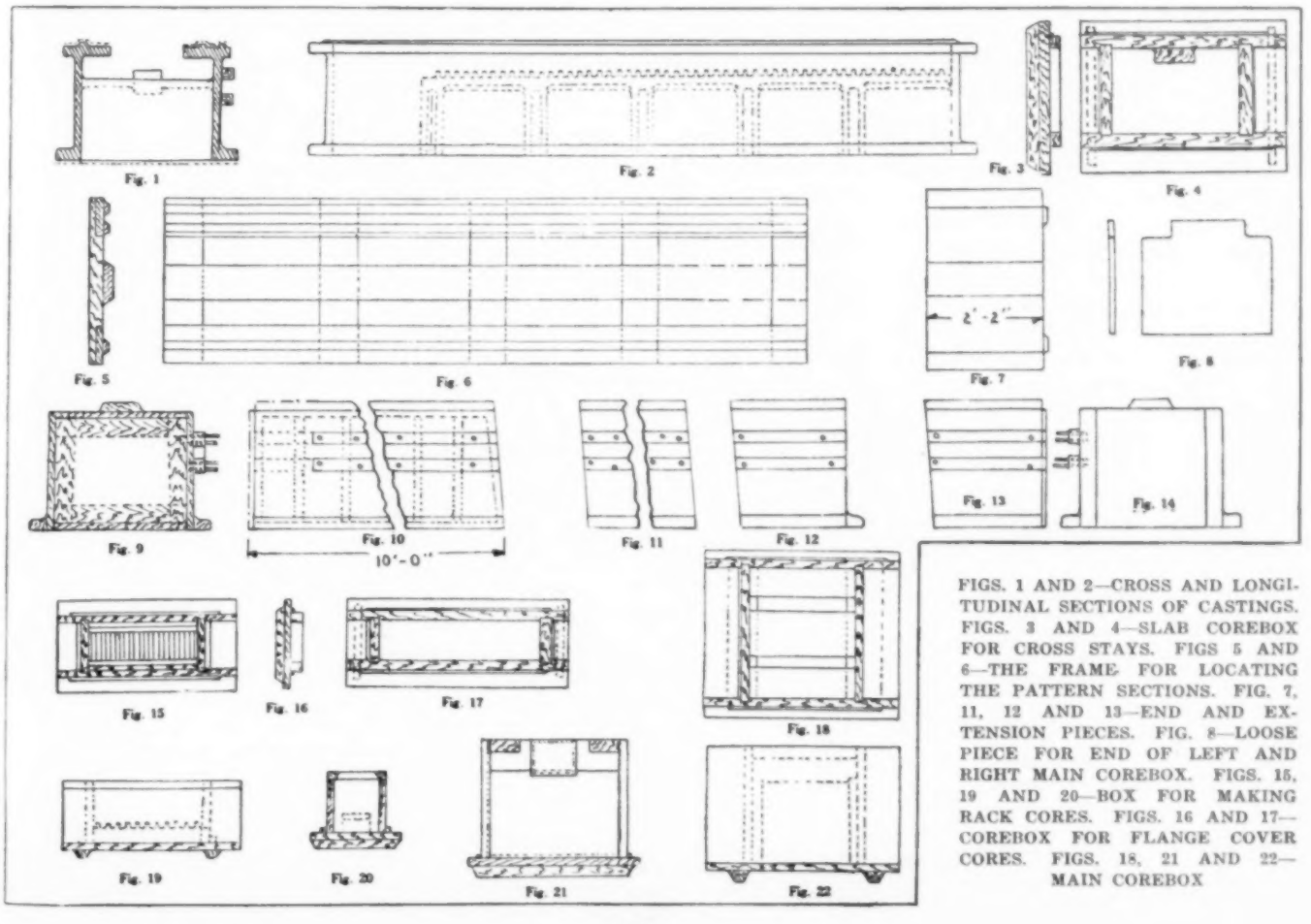
One Set of Seven Sectional Patterns Designed to Be Assembled Into Practically Any Length for Lathe Bed Castings Between 12 and 60 Feet

By J. G. Fitzpatrick

THE pattern shown in the accompanying illustrations was constructed in a way to make lathe beds from 12 to 60 feet in length in a wide range of intermediate lengths. Construction of the pattern in several sections presented several advantageous features including facility in handling and transportation. A lathe bed pattern 60 feet long would be cumbersome and awkward to ship or handle and in all probability either would warp out of shape or get broken or both. Such a pattern would have to be *cambered* or *bowed* abnormally to insure a straight casting. Experience gained from close observation of design and all other factors involved enables the practical foundryman to calculate to a nicety the proper degree of *camber* to allow so that the casting will pull itself back to the required normal straight line. This is essential for machining allowances on a lathe bed casting are limited.

Seven sections were made to the following lengths, 10, 8, 6, 4 and 2 feet. Also one joint and one end piece each 2 feet long was made. The boxed type parts are shown on the drawing Figs. 10, 11, 12, 13 and 14. A full size layout showing the necessary machining allowance was made as shown in Figs. 1 and 2. Lumber 1⅜ inches thick was selected for the top, bottom and sides of the pattern and a series of frames was made out of 2 x 4-inch lumber. These were half lapped at the corners and made to the following dimensions 2 feet 5¾ inches at the bottom, 2 feet 5¼ inches at the top and 1 foot 11¼ inches high.

These were set up and spaced on 2-foot centers. The sides were cut, dressed to 10 feet long by 2 feet 2 inches wide, one end cut square and the other cut vertically on a 2-inch bevel. They were glued and screwed to the edges of the frames. The top and bottom were dressed to drop in between the sides and were secured in the same manner. The holes for the screws were counter-bored with a center bit and afterward plugged. Dressed and sanded the pattern measured 10 feet by 2 feet 8½ inches at the base; 9 feet 10 inches by 2 feet 8 inches at the top and 2 feet 2 inches high. Four lifting irons set at a suitable distance apart were let into and made flush with the sides. Rapping plates were let into and screwed at the bottom. The base flanges 2¾ x 3 inches thick were screwed to the sides. A core print 10 inches wide 1¾ inches thick and tapered to 7½ inches wide was centered on the top 2 feet from one end and flush with the other end. The apron guides 2¼ x 2¼ inches were dowelled on to one side and set in



FIGS. 1 AND 2—CROSS AND LONGITUDINAL SECTIONS OF CASTINGS. FIGS. 3 AND 4—SLAB COREBOX FOR CROSS STAYS. FIGS 5 AND 6—THE FRAME FOR LOCATING THE PATTERN SECTIONS. FIG. 7, 11, 12 AND 13—END AND EXTENSION PIECES. FIG. 8—LOOSE PIECE FOR END OF LEFT AND RIGHT MAIN COREBOX. FIGS. 15, 19 AND 20—BOX FOR MAKING RACK CORES. FIGS. 16 AND 17—COREBOX FOR FLANGE COVER CORES. FIGS. 18, 21 AND 22—MAIN COREBOX

— BILL OF MATERIAL —

NO OF PIECES USED	MAIN PATTERN	EXTENSION PIECES			END PIECE	JOINT PIECES R^T H	JOINT PIECES L^T H	TO MAKE LATHE BED LENGTH	
2	10'-0"				2'-0"			12'-0"	
3	10'-0"	2'-0"			2'-0"			14'-0"	
3	10'-0"	4'-0"			2'-0"			16'-0"	
3	10'-0"	6'-0"			2'-0"			18'-0"	
3	10'-0"	8'-0"			2'-0"			20'-0"	
4	10'-0"	8'-0		2'-0"	2'-0"			22'-0"	
4	10'-0"	8'-0"		4'-0"	2'-0"			24'-0"	
4	10'-0"	8'-0"		6'-0"	2'-0"			26'-0"	
5	10'-0"	8'-0"	6'-0"	2'-0"	2'-0"			28'-0"	
5	10'-0"	8'-0"	6'-0"	4'-0"	2'-0"			30'-0"	
5	10'-0"	8'-0"	6'-0"	4'-0"		2'-0"		30'-0"	60'-0"
5	10'-0"	8'-0"	6'-0"	4'-0"	2'-0"	EXTEND CORE PRINT AND APRON GUIDES USE PLANING STRIPS		30'-0"	

FIG. 23—SHOWING COMBINATION OF PATTERN SECTIONS REQUIRED TO MAKE LATHE BEDS UP TO 60 FEET IN LENGTH

the same relation as the core print. The remaining six sections were constructed in a similar manner but with dimensions conforming to the respective sections shown on the drawing. Patterns and loose pieces were given two coats of orange shellac and the core prints two of black.

The inside of the casting included a series of cross stays 4 inches wide spaced on two foot centers and cored to leave 1¼-inch metal. A rack with teeth on a 2-inch pitch bridged the stays and extended practically from one of the casting to the other. Special cores were required to form the rack and the ribs.

In the rack corebox shown in Fig. 15, the sides and ends were made from 2-inch lumber with the ends set into grooves in the sides. The box 10 x 12¾ x 24 inches was beveled on the lower part inside to correspond to the print on the pattern and was mounted on a suitable bottom board. The block supporting the teeth was 6 inches wide and 3 inches thick. The box contained 11 teeth, it was parted at diagonally opposite corners with the joint of the cores in the space between the teeth.

The main corebox Figs. 18, 21 and 22 made from 2-inch lumber was 2 feet long, 2 feet 5½ inches wide and 2 feet 2 inches deep. The ends were checked into grooves in the sides. This box was mounted on a bottom board and parted at two diagonally opposite corners. Two end pieces 2¼ x 18⅝ inches designed to form the outside of the cross stays were placed on the inside of the box. Two pieces 2⅜ x 6¾ x 24 inches were set on the sides flush with the face of the box form the thickness and width of the bed at the face. A block 8 x 10⅛ inches formed a gap in the core where it straddled the rack core. In making the two end cores the end piece was replaced alternately at either end by the loose piece Fig. 8 to form a right and left section. Detail of construction of the corebox Fig. 3 and 4 was similar to the foregoing. Cores from this box 2 x 16⅝ x 27½ inches were used to form a chamber in the cross stays. The covering corebox Figs, 15, and 16, 1½ x 6 x 36 inches also was made after the same general design.

A frame with the necessary machining allowance for a 12-foot bed is shown in Figs. 5 and 6. The inverted *V* shaped guides and the rack core prints are fastened to one side. The print is shown set to a distance of 27 inches from one end, but flush with the other end. In size and position it corresponds with the core print on the 10-foot section.

Making the Mold

This frame was adjusted level in a suitable pit in the floor where the sand was rammed around it and scraped off flush with the upper surface for a distance of 8 inches. The frame then was removed and the 10-foot section of the pattern followed by the 2-foot section Fig. 12 was lowered into place guided by the core prints. The covering cores from the box Fig. 17 were placed against the sides and ends of the pattern to form the lower flange after which sand was rammed around the pattern up to the floor where a joint was made for the cope. The cope was rammed and lifted in the usual manner after which the main pattern was removed followed by the apron guides which were drawn in. Then the mold was finished and made ready for the cores.

Five rack cores were lowered end to end in the long print that extended from one end almost to the other end in the center of the mold. These were followed by six main cores made in the corebox Figs. 18, 21 and 22. Four of these cores were alike in every particular with a gap in the bottom center to provide a thickness for the metal over the rack teeth and with the loose pieces in the ends to form the cross stays in the casting. The two end cores were slightly different. The core for the extreme left end of the casting as it is shown at the extreme top center of the illustration Fig. 2 was made without the rack block in the center. The core for the extreme right end was provided with the block, but the plain stopoff piece Fig. 8 was used in the outside end of each box instead of the loose piece designed to form part of the cross stay. A lightening core made from the box Figs. 3 and 4 was placed between each pair of cores and held in place with chaplets.

Up to 12 feet in length no camber is necessary in the pattern if it is designed properly, but in long castings particularly those between 20 and 30 feet a certain amount of camber must be provided in the pattern to insure a straight casting. Two 30-foot beds were cast to fill an order for a 60-foot lathe. The same frame was used to form the bottom impression but it was drawn along in a straight line and cambered the proper amount with the aid of a line and level. In placing the pattern, the 10-foot section was followed in succession by one 8 feet long, one 6 feet, one 4 feet and the right joint piece Fig. 11, 2 feet in length and provided with planing strips at the end.

Some slight changes were required on the main pattern and frame for the second 30-foot casting. The core prints and the apron guides were continued for the full length. The various sections were assembled on the bed as in the first instance, but instead of using the end piece with planing strips for the joint end, we used the end piece Fig. 13 and placed the planing strips on the front end of the 10-foot section.

Milestones in Foundry Progress

As Recorded in the December Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

1896

GROVER CLEVELAND

MOLDING and casting statuary was the subject of the leading article in the December, 1896 issue of THE FOUNDRY. The plant described was the Gorham Mfg. Co., Providence, R. I., still a prosperous producer of exceptional work in precious and semi-precious metals. The silver statue of Christopher Columbus, made for the World's Fair in Chicago was given special attention in the recounting of molding procedure.

* * *

Thinking is accelerated by being confronted with facts. The man who mistook lime for plaster-of-paris passed through a period of deep thought before he found out why the mixture refused to become solid.

KRANK'S KORNER

* * *

RUTHLESS RHYMES

Pattern boy Joe, in a moment of error,
Took seidlitz powders for an inward ache.
He found, too late, to his grief and terror,
'Twas plaster-of-paris. Regrettable mistake.

A. V.

* * *

Tom Bowers advised his boss, Pokey, to give up the few inadequate salamanders which only served to warm the molders on one side, and install a real foundry heating system.

* * *

This advice would not be out of order in some shops still in existence.

* * *

James A. Becket recommended the increased use of the transverse test for cast iron. He advised machining bars to uniform size or failing in that to record the weight and the exact measurement of the breaking section. He favored the square bar.

* * *

Henry Hansen told of the trouble encountered when holes left in cores in which to insert hooks for lifting, were filled with paste, wet clay or oil moistened sand. He advised plain green sand with only enough paste around the broken core to moisten the parts next to the green sand patch.

* * *

The second meeting of the newly organized Pittsburgh Foundrymen's association was held Nov. 30 and a round table on tests was reported.

* * *

The Griffin Wheel Co., Chicago, purchased the American Foundry Co. plant, Tacoma, Wash. and was revamping it to make car wheels.

Faked Foundry Facts

The Wind Box

1906

THEODORE ROOSEVELT

PH. BONVILLAIN, Ph. Bonvillain & E. Ronceray, Paris, France, described in complete detail the equipment and machines for a new type of molding. The machines were operated by hydraulic pressure, and all patterns were mounted on plates.

* * *

E. R. Ronceray, mentioned as a member of the firm whose work was described in the issue of December, 1906, was the guest of American foundrymen and the recipient of the J. H. Whiting Medal at the Detroit convention of the American Foundrymen's association, this fall.

* * *

Westinghouse Electric & Mfg. Co. brass foundry at East Pittsburgh, Pa., was featured in an illustrated article. Twelve crucible furnaces and nine of the open flame type comprised the melting equipment.

* * *

H. N. Tuttle described a method of making multiple coreboxes.

* * *

Mr. Tuttle, who still is an active and frequent contributor to THE FOUNDRY now resides in Battle Creek, Mich.

* * *

A movement was under way to interest brass foundrymen in the formation of an organization affiliated with the American Foundrymen's association. The convention of the latter association was scheduled for May, 1907 at Philadelphia.

* * *

The Fort Pitt Malleable Iron Co., Pittsburgh, was planning to erect large additions to its plant at McKees Rocks, Pa.

1916

WOODROW WILSON

CHARLES V. SLOCUM described the use of air furnace iron for car wheels, in THE FOUNDRY of December, 1916. Uniformity was the principal advantage claimed for this method of melting for car wheel castings.

* * *

Divisional patterns for cast iron columns were treated in an article by R. Robertson.

* * *

No. 2 foundry iron ranged from $26.95 to $28 in the north and from $20 to $23 in the south. An increasing demand for castings was noted, labor was scarce and transportation problems were multiplying.

* * *

Expansions and additions to foundries were under way to keep up with the added demand for castings. The new construction activities were by no means confined to the larger existing organizations. Many new incorporations gave a hint of the extension of foundry plant facilities which soon was to follow.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Who Pays the Foundryman?

WHEN Mr. Ford announced his plan for permitting each employe to work five days in the week, with earnings to be the same as those received for six days' labor, he started discussion which will terminate only with the general adoption or rejection of the plan. Always original in manufacturing ideas, Mr. Ford never fails to win attention for his suggestions and with few exceptions, his innovations have come to be adopted generally. Consequently, the results of this experiment will be watched closely, particularly as it affects output and economy of operation. The problem is one of management, particularly as applied to sychronizing operations already highly specialized in the Ford plants; the addition or improvement of mechanical aids; and finally the cooperation of the men concerned. Obviously if the men can earn as much in five days as they formerly could in six, they should be satisfied with the arrangement.

FROM time to time, throughout the foundry industry, the five-day week is followed; but usually through necessity. When business is slack and orders are scarce shops curtail their operating schedules and many, instead of reducing the force shorten the time each week during which their plants are active. Unfortunately, such occasions arise at times when competition is most sharp and when prices are cut to the bone. Castings manufacturers reduce their working time to five days per week, but no one considers paying them for six days' work.

UNDER such conditions the buyers of castings do not emulate Mr. Ford and offer to pay premiums on their purchase price per pound. After all, should they not be charged a higher unit price? When a foundry is working at a reduced rate, production costs mount, since practically all of the items of general overhead take no holiday, but continue to add their load to the total cost per pound. The fallacy that work should be accepted at ruinous prices, "to keep the shop open," has been punctured with enthusiasm by various foundry cost accountants. Perhaps at some time it may be exploded entirely. Until such time, foundries forced to work upon a reduced schedule should watch their costs most carefully. They should insist upon five days' pay for five days' work, if they cannot obtain the full Ford return upon their operating plant and equipment.

¶ Has It Come To Stay?

POLICY of hand-to-mouth buying adopted by many industrial concerns during the past few years has aroused considerable discussion among leaders of industry and students of economics. Conservatives condemn the idea of keeping stocks of raw materials only a few days ahead of manufacturing schedule. Supporters of the new school claim that the industrial prosperity of the past year largely is due to a system which kept the brake on extravagant buying programs. Prosperity cannot be threatened by the bogie of surplus stocks so long as hand-to-mouth buying prevents a surplus.

PRESENT day methods of supplying grist for the universal industrial mill would have been out of the question a few short years ago. Record breaking tonnages and assured delivery of the shipment at the destination in the shortest possible time are due to competent railroad management. Motor trucks and hard surfaced roads also have helped to bridge the time gap between producer and consumer.

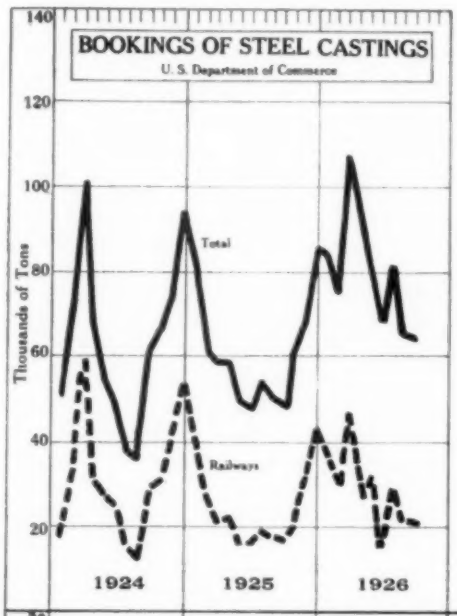
WHILE hand-to-mouth buying policy seems to have much in its favor, the capable buyer will not follow the theory blindly. No difficulty may be experienced now in securing rapid movement of freight, but at any time embargoes or other conditions possibly may arise which will necessitate closing down the plant. For example among other factors, foreign demand for coal may increase the prices of certain necessary commodities. Before committing himself to a rigid hand-to-mouth buying policy the wise man will make a careful study of market conditions and shape the program if his future expenditure accordingly.

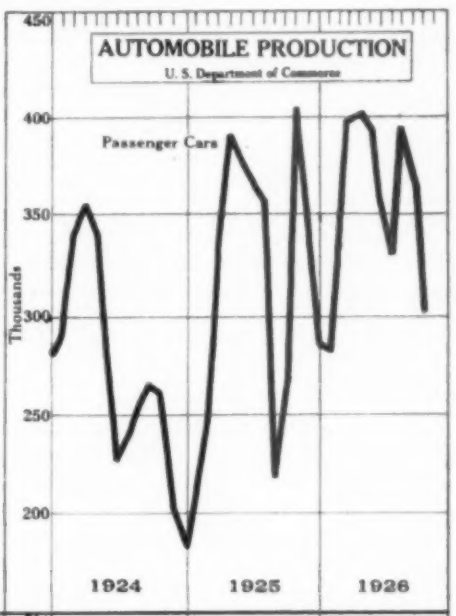
Trade Trends in Tabloid

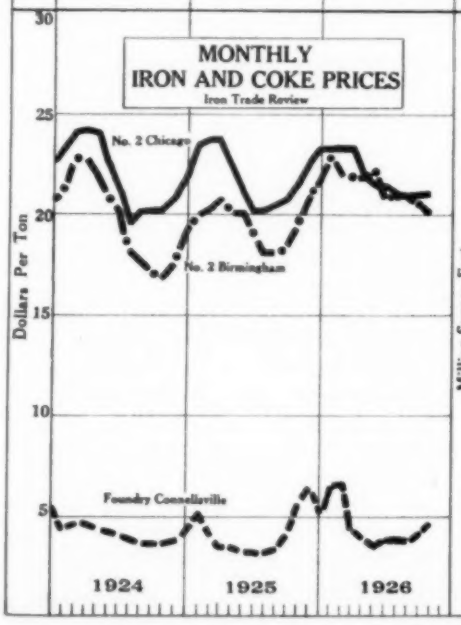
ALTHOUGH slight declines are noted in foundry operations in several sections of the country, due partly to a slackening in some industries for the inventory period, the foundry industry as a whole is operating at a satisfactory rate. A seasonal falling off in the production of automobiles also is having some effect on the foundry industry. The level of building construction continues high, although a distinct downward shift in new contract awards was shown in October. Car loadings are being maintained at a record rate and railroad earnings are high, but expenditures for new equipment continue to lag. Orders for sanitary ware are considerably below the total for a year ago. The average melt in Ohio as reported by the Ohio State Foundrymen's association was 81.3 per cent of normal in October as compared with 85.8 per cent in September and 92.5 per cent in October, 1925. Stocks of materials received declined from 85 per cent in September to 58 per cent in October. Nonferrous operations increased from 78 per cent of normal in September to 81.8 per cent in October. Complaints are made here and there that prices are being cut to a ruinous figure by some foundrymen to meet competition. October bookings of steel castings were 56 per cent of shop capacity compared with 51 per cent in September. Bookings totaled 72,270 tons in October.

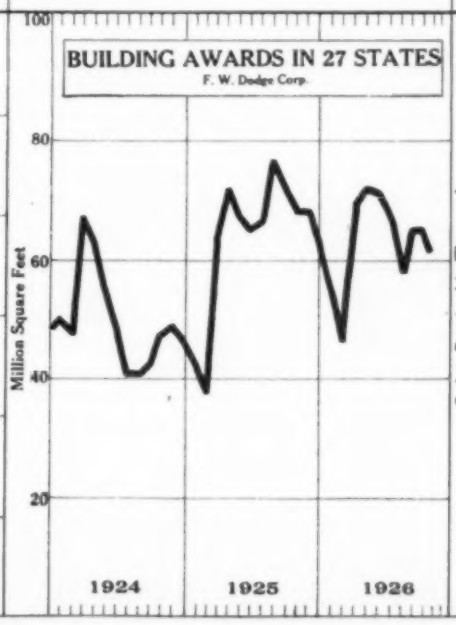
RAW MATERIAL PRICES

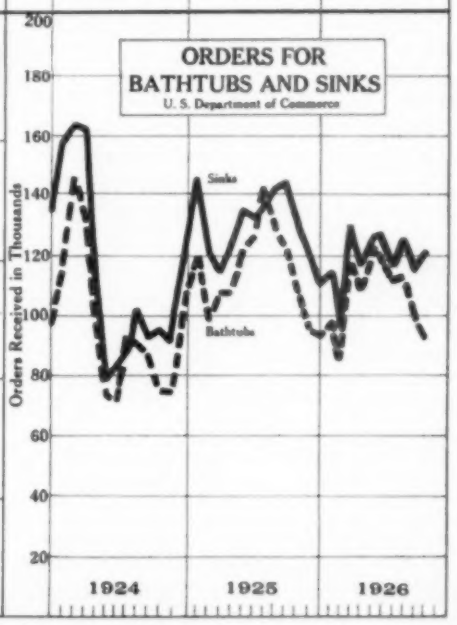
Iron	
No. 2 foundry, Valley	$20.00
No. 2 southern Birmingham	20.00
No. 2 foundry, Chicago	21.00
No. 2 foundry, Philadelphia	23.76 to 24.13
No. 2 foundry, Buffalo	20.00
Basic, Valley	19.00
Basic, Buffalo	19.00
Malleable, Chicago	21.00
Malleable, Buffalo	20.00
Coke	
Connellsville foundry coke	$4.50 to 5.00
Wise County foundry coke	6.00 to 7.00
Scrap	
Heavy melting steel, Valley	$16.00
Heavy melting steel, Pitts.	17.00 to 17.50
Heavy melting steel, Chicago	13.00 to 13.50
Stove plate, Chicago	14.00 to 14.50
No. 1 cast, New York	14.50 to 15.00
No. 1 cast, Chicago	16.50 to 17.00
No. 1 cast, Philadelphia	17.50 to 18.00
No. 1 cast, Pittsburgh	16.00 to 16.50
No. 1 cast, Birmingham	16.00 to 17.00
No. 1 cast, Buffalo	15.25 to 15.75
Car wheels, iron, Pittsburgh	16.50 to 17.00
Car wheels, iron, Chicago	14.75 to 15.25
Railroad malleable, Chicago	16.50 to 17.00
Agricultural, mall., Chicago	15.25 to 15.75
Malleable, Buffalo	17.50 to 18.00
Railroad Malleable, Pitts.	17.00 to 17.50
Nonferrous Metals	Cents per pound
Casting copper, refinery	13.37½ to 13.40
Electro copper, producers	13.75
Straits tin	72.50
Lead, New York	8.00
Antimony, New York	14.25
Nickel, electro	39.00
Aluminum, No. 12, prod'rs	25.00
Aluminum, No. 12 remelt	22.00 to 22.50
Zinc, E. St. Louis, Ill.	7.20 to 7.22½











Comings and Goings of Foundrymen

GEORGE P. ABORN, manager, Worthington Pump & Machinery Corp., East Cambridge, Mass., recently was tendered a dinner by his business associates in commemoration of the fortieth anniversary of his connection with the firm. Mr. Aborn became associated with the Knowles Steam Pump Works, Warren, Mass., on Oct. 4, 1886 as mechanical engineer. In 1897 the company consolidated with the George F. Blake Mfg. Co., under the name of Blake & Knowles Steam Pump Works and moved to East Cambridge. In 1914 the firm was absorbed by the Worthington Pump & Machinery Corp. Mr. Aborn has been manager of the East Cambridge plant since 1905.

F. W. Roebling Jr., treasurer and director of the McFarland Foundry & Machine Co., Trenton, N. J., has been elected president of the John A. Roebling's Sons Co., Trenton, N. J.

F. A. Kroll, formerly engaged in metallurgical engineering in Houston, Texas, now is president of the Texas Electric Steel Castings Co., Houston. F. G. Sowden formerly with the Minneapolis Steel & Machinery Co., is vice president.

H. Webster Jr., Pacific Malleable Castings Co., Oakland, Calif., now is in the sales department of the firm. He became associated with the company in 1924 and has worked in various departments of the plant including the gray iron and brass shops.

George C. Mills has been appointed sales representative for the Vulcan Mold & Iron Co., Latrobe, Pa. For the past year Mr. Mills has been Pittsburgh representative for the Vom Baur Engineering Corp., New York. He also was Pittsburgh agent for Naylor & Co., New York for 25 years.

Edward J. Medart, Fred Medart Mfg. Co., St. Louis, has resigned as president and treasurer of the company. Philip S. Medart, his brother, who has been vice president of the firm for 18 years was elected to fill the vacancy. William T. Mellow was elected vice president to succeed Philip S. Medart. Mr. Mellow also is vice president of the Liberty Foundry Co.

George E. J. Pistor, elected treasurer of the American Institute of Steel Construction at its recent convention, has had a long career in the structural industry. He was graduated from Cornell university, Ithaca, N. Y., in 1901 and entered the drafting room of the McClintic-Marshall Co., Rankine, Pa. Later he joined the Hay Foundry & Iron Works, Newark, N. J. For the past ten years he has been contracting manager for the Hay company.

Edward A. Permar, who now is superintendent of the foundry, Scranton Pump Co., Scranton, Pa., entered the foundry industry through the pattern shop. He served as an apprentice patternmaker at the Diamond State Steel Co., Wilmington, Del., later becoming patternmaker, foundry foreman, superintendent, and production manager. For a time Mr. Permar was production manager for the Roxbury Steel Co., Boston, and also was superintendent of the foundry for M. W. Kellogg Co., Jersey City, N. J.

Vincent Massey, formerly president of the Massey-Harris Co., Toronto, Ont., has been appointed Canadian minister to Washington. He was graduated from the University of Toronto and later studied at Oxford university, England. The earlier years of his career were spent in educational work and during the war he held the rank of lieutenant colonel. In 1918 he was appointed associate secretary of the war committee of the Canadian federal cabinet. In 1919 Mr. Massey was appointed secretary and director of the Massey-Harris Co., agricultural implement manufacturer. He was chosen president in 1921 which position he held until 1925 when he resigned to enter the cabinet of W. L. Mackenzie King as minister without portfolio.

Hold Annual Convention

At the thirtieth annual convention of the National Founders' association held at the Hotel Astor, New York, Nov. 18, William H. Barr, William H. Barr Inc., Buffalo, was re-elected president. W. A. Griswold, Gray & Dudley Co., Nashville, Tenn., was elected vice president to succeed L. R. Clausen; A. E. McClintock, Chicago, was reappointed commissioner and J. M. Taylor, Chicago, secretary. More than 200 members attended the meetings where important phases of the foundry industry were discussed. James A. Emery, Washington, presided over the banquet which was featured by an address by K. V. Kaltenborn, associate editor, *Brooklyn Daily Eagle*, Brooklyn, N. Y., on present day conditions in Europe. M. C. Rorty, International Telephone & Telegraph Co., also spoke on business conditions.

Officers Are Elected

At the fifteenth annual congress of the National Safety council held recently in Detroit, the following officers were elected for the metals section: F. G. Bennett, director of safety, Buckeye Steel Castings Co., Columbus, chairman; J. A. Northwood, superintendent of safety, Bethlehem Steel Co., Johnstown, Pa., vice chairman; E. G. Quesnel, safety engineer, Commonwealth Steel Co., Granite City, Ill., secretary; John P. Eib, supervisor of safety and labor, Illinois Steel Co., Joliet, Ill., chairman program committee; F. H. Rowe, safety director, Wheeling Steel Corp., Portsmouth, O., chairman, bulletin committee; H. G. Hensel, safety director, Youngstown Sheet & Tube Co., Chicago, chairman, membership committee; Earl F. Blank, safety director, Jones & Laughlin Steel Corp., Pittsburgh, engineering representative. In addition to the officers, the executive committee is composed of A. C. Gibson, Spang, Chalfant & Co., Pittsburgh; T. H. McKenney, Illinois Steel Co., South Chicago, Ill.; John Oartel, Carnegie Steel Co., Pittsburgh; J. M. Woltz, Youngstown Sheet & Tube Co., Youngstown, O.

Increase Production of Secondary Aluminum

France in 1925 was the leading producer of bauxite from which metallic aluminum, aluminous abrasives, refractories and cements are manufactured. France produced 406,535 metric tons, United States 321,620 metric tons and Italy 195,000 metric tons according to a bureau of mines pamphlet on bauxite and aluminum in 1925. Less bauxite was produced in the United States in 1925 than in 1924 owing to larger imports. Domestic production decreased 9 per cent most of which was in the Arkansas field, the largest producing state. Imports of bauxite increased 75 per cent.

Value of new aluminum produced

in the United States in 1925 was 3 per cent less than in 1924, and the value of secondary aluminum was 70 per cent greater. Growth in the use of aluminum paints for both inside and outside work has continued and railroads are building or have built cars in whose construction much aluminum has entered. Development of aluminum alloys, has necessitated much research work.

Hold Joint Meeting

At a joint meeting of the Philadelphia Foundrymen's association and the Philadelphia chapter of the American Society for Steel Treating held at the Engineers club, Philadelphia on Nov. 19, Dr. Paul D. Merica, director of research, International Nickel Co., New York, gave a comprehensive address on the effects of nickel on cast iron. He said that the addition of nickel increased the brinell hardness of cast iron and decreased the chilling tendency. To obtain the full benefit of nickel, the silicon should be reduced by one-half of the nickel added. Maximum results are obtained by the addition of 5 to 10 per cent nickel. C. R. Cary, Leeds & Northrup Co., Philadelphia, recently returned from a trip to Japan, told of his impressions of that country.

Walt Baylie now is district manager of New England territory for the Louden Machinery Co., with offices at 1106 Old South building, Boston.

Hear Talk on Sandblast

The eighty-ninth meeting of the Connecticut Foundrymen's association was held at the Hotel Winthrop, Meriden, Conn., on Nov. 12. James Rigby Jr., American Foundry Equipment Co., New York, described the various uses of sandblasting. He discussed the various types of sandblasting equipment and emphasized the proper selection of type and abrasive to obtain the best results on the work at hand. Details of operating costs were given for the various types of equipment including necessary allowances for depreciation, interest, power, air consumption, abrasives and repairs.

Foundry Firms Merge

Consolidation of the Aetna Foundry & Machine Co., Warren, O., with the Standard Engineering Co., Ellwood City, Pa., recently has been completed. Officials of both companies continue as active executives in the new alignment of interests. Officers of the new firm are: M. I. Arms, president and treasurer; R. C. Stiefel, vice president; R. J. Wean, vice president; J. R. Paisley, secretary; I. S. Taylor, assistant secretary and treasurer. The new firm will be known as the Aetna-Standard Engineering Co. Both firms manufacture various types of machinery such as bar and sheet mills and galvanizing machines for rolling-mills.

Obituary

Walter R. Bertsch, vice president, Bertsch & Co., Cambridge City, Ind., builder of metal working machinery, died recently.

John G. Haubrichs, for 12 years secretary and treasurer of the General Model & Pattern Co., Cleveland, died on Nov. 2 . He was 56 years old.

C. A. Rapallo Dies

Charles A. Rapallo, secretary, Robeson Process Co., New York, maker of core-binder materials died recently, aged 63 years. He had been associated with the company for 20 years, holding his secretarial position throughout virtually the entire period.

From 1918 to 1923, he was also in charge of foundry sales. Mr. Rapallo was born in New York and was graduated from Columbia university. Prior to his affiliation with the Robeson company, he was in the traffic department of the Delaware, Lackawanna & Western railroad.

Moves Boston Office

The Link-Belt Co., Chicago, has removed its Boston office from 49 Federal street to 1103-1104 Statler building. E. J. Burnell is manager of this office.

Foundry Association Directory

American Foundrymen's Association

President, S. W. Utley, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. Hoyt, 140 South Dearborn street, Chicago; technical secretary, R. E. Kennedy, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. McARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, CHARLES L. LARSEN, Armour Insitute of Technology, 3200 Federal street Chicago; secretary, ROGERS A. FISKE, 105 LaSalle street, Chicago. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, ROBERT G. CRAWFORD, Atlas Foundry Co., 131 South Artillery street, Detroit; secretary, RUSSELL M. SCOTT, Packard Motor Co., 1580 East Grand boulevard, Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

Metropolitan Brass Foundry Association
New York

President, THOMAS HARPER, Thomas Harper, 204 Lafayette street, New York; secretary WM. E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meetings second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry, Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meetings called by president.

New England Foundrymen's Association

President, H. P. BLUMENAUER, Arcade Malleable Iron Co., Worcester, Mass.; Secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, WALTER L. SEELBACH, Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, J. W. Paxson Co., Luzerne and D streets, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association
Pittsburgh

President, LAWRENCE V. STEVENS, Locomotive Stoker Co., N. E. Pittsburgh; secretary-treasurer, WM. J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President J. H. DIEDRICH, Blackhawk Foundry & Machine Co., Davenport, Iowa; secretary-treasurer, A. D. ZIEBARTH, Davenport Foundry & Machine Co., Davenport, Iowa. Meetings the third Monday evening of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary-treasurer, W. E. DUNN JR., Healey building, Atlanta, Ga.

Tri-City Technical Council
Moline, Ill.

Chairman, H. BORNSTEIN, Deere & Co., Moline, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, J. A. TEACH, Minneapolis Steel & Machinery Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, So., Minneapolis. Meetings monthly at the Athletic club.

Handles Materials

The Harnischfeger Corp., Milwaukee, recently has introduced a gasoline engine driven unit which may be used as a shovel, skimmer scoop, hoe, dragline, pile driver, clamshell or crane. The change from one model to another may be made quickly by a special drum spider and lagging.

THE UNIT WITH THE ELECTRIC MAGNET MAY BE USED IN THE FOUNDRY FOR HANDLING SCRAP, PIG IRON AND CASTINGS

It is not necessary to change the drum but merely the lagging.

The unit is constructed entirely of steel to secure rigidity. The revolving frame, car body, drum side stands, etc. are one piece steel castings. The tractions are provided with two speeds, the high speed permitting fast travel and the low speed giving a large tractive pull.

All shafts are chrome manganese steel and the heavy duty shafts are forged and heat treated. The gears also are heat treated. A view of the unit equipped with an electric lifting magnet for handling scrap and other materials in the foundry, is shown in the accompanying illustration. The electric magnet is manufactured by the Ohio Electric & Controller Co., Cleveland.

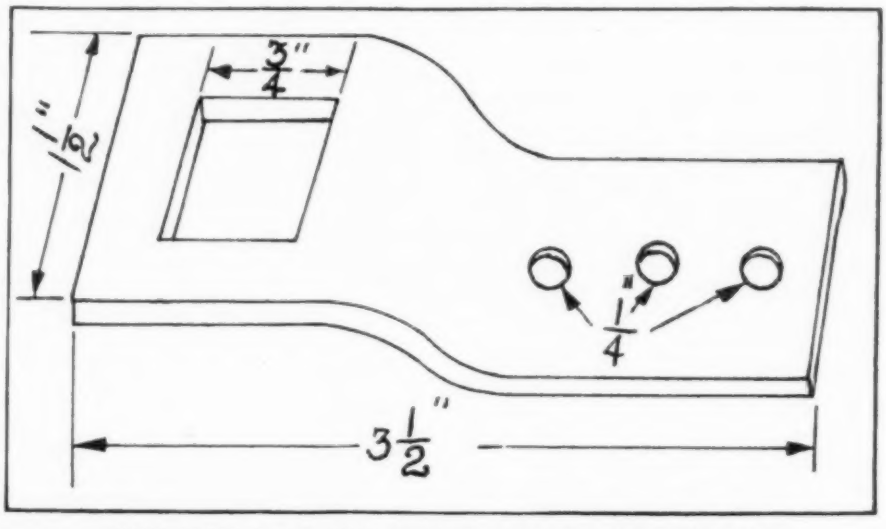
Discuss Merchandising

Sales representatives of the Electric Steel Founders' Research group recently held a convention at the Edgewater Beach hotel, Chicago, to consider the basic principles of merchandising small and medium sized steel castings. Papers at the meeting were read by C. E. Stone, vice president and general manager, Interstate Drop Forge Co., Milwaukee; Walther Buchen, president, the Buchen Co., Chicago and W. J. Corbett, secretary, Steel Founders' Society of America.

Keeps Nut from Turning

By M. R. Burns

On a long running job on a plain jolt machine trouble was experienced at times with the nuts working loose on the pattern plate pins. This resulted in shifted castings. Finally two lock nuts according to the accompanying sketch were made from a piece of 3/16-inch strip steel and attached to the board with wood screws. The ¾-inch opening fitted over the nut on the pin and prevented it from revolving. In case hexagonal nuts are used, the opening will hold.



THIN STEEL LOCK NUT IS SCREWED TO THE PATTERN BOARD

Tablet Is Unveiled

A tablet on the Seth Boyden monument in Washington Park, Newark, N. J., was unveiled on the anniversary of Boyden's birth, Nov. 17. The tablet enumerates his many achievements, the discovery of black heart malleable iron being only one. The committee in charge of the tablet and its unveiling was comprised of Arthur E. Barlow, Frederick L. Eberhardt, Theodore S. Miller and Stephen J. Miller.

Purchase Company

Chain Belt Co., Milwaukee, has purchased the Stearns Conveyors Co., Cleveland. This increases the number of affiliated companies to five. Other firms are the Sivyer Steel Castings Co., the Federal Malleable Co., and the Interstate Drop Forge Co., all of Milwaukee. The Stearns company will continue to operate as a separate organziation with Earl D. Stearns remaining as president.

Corporation Is Formed

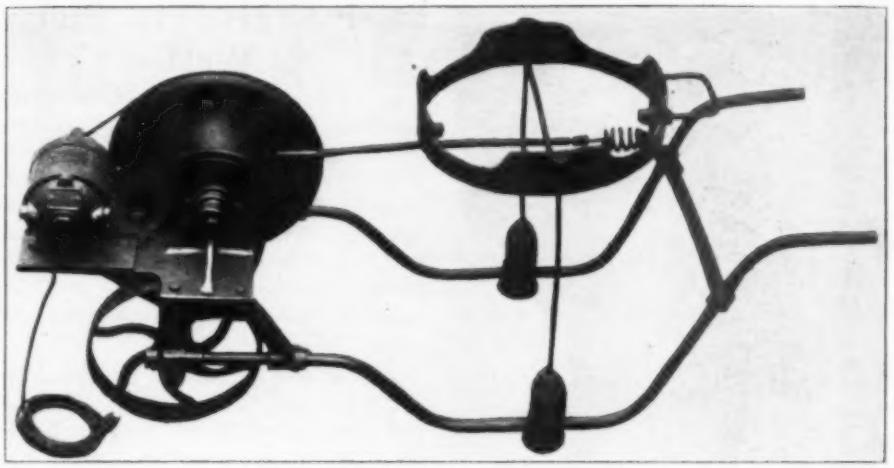
The Pittsburgh Die Casting Corp., Swissvale, Pa., has been formed to take over the business of the Pittsburgh Die Casting Co. Improvements to buildings and equipment will be made. The following are officers of the new corporation: H. F. Messersmith, president and manager; H. M Meixner, vice president; Howard G. DeVan, secretary, and F. M. Townsend, treasurer.

Edward J. Costello Jr., has become associated with sales organization of the Blaw-Knox Co., Pittsburgh and will represent the company in the territory adjacent to the Philadelphia office.

Portable Sand Riddle Is Hand Operated

The Adaptable Moulding Machine Co., Birmingham, England, recently has introduced a hand operated sand riddle. The operation of the machine is simple, it is claimed, since a slight pull on the handle attached to the riddle container sets the power wheel in motion and in turn keeps the riddle container oscillating. Ample room is allowed for an 18-inch riddle of any mesh to be removed and replaced while the machine is in operation. The container is so designed that the riddle rides on a rocker giving an impact with every oscillation.

By the substitution of a pulley for the power wheel and the addition of a motor, the electric motor driven type machine is available, similar to the one shown in the accompanying illustration. The frame consists of two wrought iron tubes on which the entire machine is assembled. The riddle container is supported on two beehive type springs while a third spring is provided at the point where the connecting rod from the flywheel is attached to the riddle container. The riddle container is aluminum and is fitted with a handle which is used to start the hand power machine. The flywheel or power wheel is fitted with ball bearings. The motor is ¼-horsepower, totally enclosed and either alternating current or direct current motors are supplied as required. Two 14-inch malleable iron wheels permit easy transportation.



THE MACHINE MAY BE OPERATED BY HAND OR DRIVEN WITH AN ELECTRIC MOTOR

Silent Hoist Winch & Crane Co., Brooklyn, N. Y., has removed its works and general offices to 762 Henry street, Brooklyn.

Portable Meter Analyzes Flue Gas

A portable electric CO_2 meter recently has been placed on the market by the Bacharach Industrial Instrument Co., 7000 Bennett street, Pittsburgh. The instrument consists of a precision profile indicator, shown at the top of the accompanying illustration and the bridge zero adjuster arranged below from left to right. To set the proper bridge current, the tumble switch is thrown into the upper position. This cuts the precision indicator into the circuit as an ammeter and the current is set to the top mark deflection by the variable resistor. Three standard dry cells are used as the source of current and are connected to the two binding posts in the lower left hand corner. When making temperature measurements, the tumble switch is thrown into the downward position, and a standard themocouple connected to the lower right hand terminals and the reading made on the millivolt scale. The temperature then is determined by means of a millivolt temperature curve.

The tumble switch is thrown into the center position for the analysis of flue gas. The gas is sampled by a hand aspirator, which draws the gas through a small amount of calcium chloride and cotton filter. When not in use this device is held in the cover of the instrument as shown in the accompanying illustration. The instrument also may be arranged to give continuous indications for short periods.

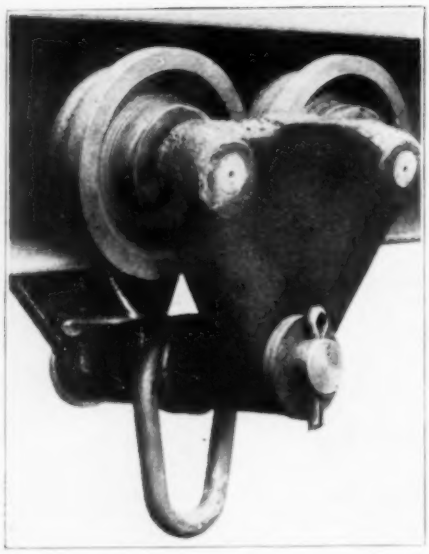
GASES MAY BE ANALYZED IN THE FIELD WITH THIS INSTRUMENT

Research Laboratories To Be Listed

National Research council is revising bulletin No. 16 which contains a list of research laboratories in industrial establishments in the United States. This list was assembled in 1921, and since then it is believed that a large number of industrial firms have established research laboratories. To make the new bulletin as complete as possible, firms or those in charge of research departments are requested to send a postcard giving the name and address of the firm. Questionnaires will be sent to these firms. Postcards should be addressed to the Research Information Service, National Research council, B & 21st streets, Washington.

E. N. Beisheim, formerly connected with the Bock Bearing Co., Toledo, O., has been appointed assistant to the general manager of the Timken Roller Bearing Co., Canton.

S. C. Partridge has been made manager of the Buffalo office, industrial division, of the Timken Roller Bearing Co., Canton.



ROLLER BEARINGS ARE PROVIDED FOR EACH WHEEL

Makes Steel Trolley

An I-beam trolley, applicable to foundry work, has been introduced by the Northern Engineering Works, Detroit. The design permits the adjusting of the side frames to beams of other size. The trolley is adapted for the use of chain blocks, air hoists, hook on type electric hoists and I-beam cranes. The frame consists of two cast steel sides held together by a steel equalizer load pin. This pin is designed to distribute the load on all four wheels.

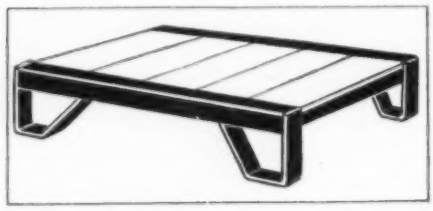
The wheels are made of a car wheel mixture, are flanged and have chilled, crowned treads, which, it is claimed, reduce track friction and wear. The wheels are carried on short steel axles and have a closed face on the inside to act as a bearing against one end of the axle for side thrusts. This construction keeps the wheel hubs free from the side frames, and thereby eliminates the friction due to the hubs rubbing together. Roller bearings are provided for each of four wheels. Particular attention has been given to making this trolley as free and easy running as possible. Up to three tons the trolley, which is shown in the accompanying illustration, usually is supplied without gearing, while above three tons and in some cases for the three-ton trolley, gearing and hand chain are recommended for traveling.

Gordon H. McCrae, London, England, vice president of the Independent Pneumatic Tool Co., Chicago, is making a visit to the home office in Chicago and the factory at Aurora, Ill. Mr. McCrae is in charge of the London office of the company.

Steel Platform Frame Is Welded

A new steel frame platform for handling materials recently has been placed on the market by the Lewis-Shepard Co., Boston. In this platform, which is shown in the accompanying illustration, the clearance from the underside of the platform to the floor permits the use of a lift truck at either of the ends or the sides.

All of the boards in the platform are protected by a steel binding and the ends especially are protected. The steel frame is a unit in itself and does not depend on the clamping of



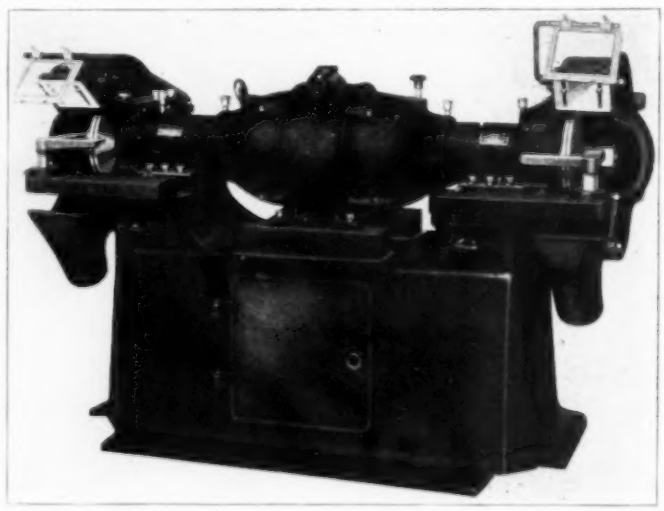
THE BOARDS ARE PROTECTED BY A STEEL BINDING

the steel frame and the feet to the wood top for strength. The entire metal structure is welded into the equivalent of one solid piece. The top of the wood platform is flat and the boards and the steel binding are flush. No. bolts or rivets are used in the construction.

Heavy Duty Grinder Has Adjustable Speed

The United States Electrical Tool Co., 2488 West Sixth street, Cincinnati, recently has introduced two heavy duty grinders applicable to foundry work. The machines have been designed to withstand continuous heavy production service under severe conditions. The machines are built in sizes from 5 to 15 horsepower and the motor may be supplied in 220, 440, 550 volts, two or three phase, 25, 40 or 60 cycle alternating current and 110, 220, 440 and 550 volts direct current. Four heavy duty ball bearings in dust proof boxes support the heavy spindle. All alternating current motors are equipped with remote control. Wheel guards are equipped with exhaust connections, hinged doors, spark breakers and an adjustable eye shield. Cast steel or heavy boiler plate guards may be supplied.

One of the machines, which is shown in the accompanying illustration, is so designed that the adjustment of the guards to the wheel wear automatically regulates the speed of the motor so that the peripheral speed of the wheels is constant, regardless of the wheel diameter. With direct current constant speed may be maintained. On alternating current, starting with a 24-inch wheel running at 900 revolutions per minute and a peripheral speed of approximately 5500 feet per minute, the wheel may be used until it is worn down to 18 inches in diameter. At this time the next speed of 1200 revolutions per minute automatically is cut in by moving the hand lever, which again brings the peripheral speed to 5500 feet per minute. The alternating current motor is a three-speed machine, running at 900, 1200 and 1800 revolutions per minute.



THE WHEEL SPEED IS REGULATED AUTOMATICALLY BY ADJUSTING THE WHEEL GUARDS

Electric Furnace Booklet

William Swindell & Bros., Pittsburgh, has published a 40-page booklet showing electric melting and annealing furnaces manufactured by the firm. A historical account of the Swindell company is given, followed by numerous illustrations of its multiple electric furnaces which consist of two furnaces mounted on a turntable with only one set of electrodes and electrical equipment, and are operated alternately. Illustrations of the single-type, electric-melting furnace and electric heat-treating furnaces also are shown.

Delay Buying of Equipment

While Inquiries Are Heavy, Many Foundrymen Are Waiting Until After the Inventory Period Before Placing Orders

MOVEMENT of foundry equipment in the various distributing centers was rather light in November. Many of the inquiries current during the past month have not developed into orders, and in some cases the sales will not be made until after the first of the year. Sales in the Cleveland territory are holding up in a few lines, such as shakeout and sandblast equipment.

Improved inquiry has failed to result in a material increase in the buying of foundry equipment in the New York metropolitan district. This is due in part to the fact that a number of inquiries are for the purpose of obtaining figures to assist in estimating budgets for the coming year. With the exception of one large project, little is noted in the way of plant construction for which sizable lists of equipment would be required. Export demand includes two inquiries for sand handling equipment for Australia.

Sustained inquiry rates for molding machines afford a direct contrast to inquiries generally for foundry equipment. The latter for two or three weeks past have dwindled considerably and in many instances buyers are waiting until they pass the inventory periods. Others will not buy until early in 1927 when new budgets are made up. The Charleroi Steel & Foundries Co., Charleroi, Pa., which has been purchasing some equipment, still is in the market for ladles, bumpers, ovens, etc. Inquiries coming to molding machine sellers are more numerous than even in the active period following the equipment exhibition. An inquiry is out for a sand mixer and other equipment from the Columbiana Foundry Co., McKeesport, Pa., which recently bought five acres of ground for expansion. Other inquiries pending involve cupolas, core ovens, and sand handling machinery.

While the foundry melt holds on an even keel in New England, equipment buying has slowed down some during the past 10 days. There is a tendency to postpone improvements and new construction. The Builders Iron Co., Inc., recently organized at Hartford, Conn., plans the purchase of considerable equipment. A foundry is being constructed at the Charlestown, Mass., state prison and complete equipment for this is to be purchased.

The foundry equipment market in Chicago territory is in a period of rather limited activity, which some think will extend to the first of the new year. Approach of inventory time, budget making and general plans for the year 1927 have cut into sales and inquiries for foundry machinery. In some lines, as in sand preparing and handling, a number of inquiries are outstanding, but interest in their closing has been deferred.

Exports of foundry and molding equipment for September were $89,429 as compared with $97,903 in August.

NEW YORK MARKET

Cranes

U. S. Cast Iron Pipe & Foundry Co., Chattanooga, Tenn., electric overhead crane from the Niles Crane Corp., Philadelphia.

Ladles

Southern Wheel Co., Rochester, N. Y., one 12-ton motor operated reservoir ladle; U. S. Cast Iron Pipe & Foundry Co., Burlington, N. J., one 10,000-pound ladle; from the Whiting Corp., Harvey, Ill.

Molding Machines

Florence Pipe Foundry & Machine Co., Florence, N. J., one molding machine from the Herman Pneumatic Machine Co., Zelienople, Pa.

Shakeout Equipment

A. P. Smith Mfg. Co., Bloomfield, N. J., U. S. Radiator Corp., Geneva, N. Y., American Locomotive Co., Dunkirk, N. Y., shakeout bails from the Stoney Foundry Engineering & Equipment Co., Cleveland.

PITTSBURGH MARKET

Core Ovens

Wheeling Bronze Castings Co., Wheeling, W. Va., one core oven from the Hill & Griffith Co., Cincinnati.

Cranes

General Electric Co., Schenectady, N. Y., two 5-ton cranes from the Whiting Corp., Harvey, Ill.

Ladles

Kanawha Mfg. Co., Charleston, W. Va., one 6000-pound ladle, Charleroi Steel & Foundries Co., Charleroi, Pa., one 9-ton steel ladle, Carnegie Steel Co., Homestead, Pa., one 12-ton helical worm geared ladle, from the Whiting Corp., Harvey, Ill.

Molding Machines

King Stove & Range Co., Sheffield, Ala., two; Monessen Foundry & Machine Co., Monessen, Pa., one, from the Herman Pneumatic Machine Co., Zelienople, Pa.

Tumbling Barrels

Sharon Hardware Mfg. Co., Sharon, Pa., one 36 x 60-inch tumbling mill from the J. S. McCormick Co., Pittsburgh, through the Marr-Galbreath Machinery Co., Pittsburgh.

CHICAGO MARKET

Molding Machines

Maynard Electric Steel Castings Co., Milwaukee, one molding machine; Nugent Steel Casting Co., Chicago, one molding machine; from the Herman Pneumatic Machine Co., Zelienople, Pa.

Sand Preparing Equipment

Small sand preparing machine for Kobe, Japan, from the Standard Sand & Machine Co., Cleveland.

Shakeout Equipment

Vogt Machine Co., Louisville, Ky., shakeout bails; Standard Sanitary Mfg. Co., Louisville, Ky., American Manganese Steel Co., Denver, American Manganese Steel Co., Chicago Heights, Ill., vibrator and shakeout equipment; Holland Furnace Co., Cedar Rapids, Iowa, core knockout machine; from the Stoney Foundry Engineering & Equipment Co., Cleveland.

CLEVELAND MARKET

Cranes

Detroit Gray Iron Co., Detroit, one 7½-ton crane from the Whiting Corp., Harvey, Ill.

Furnaces

Buffalo Forge Co., Buffalo, one cupola; Detroit Stove Works, Detroit, one cupola; Holley Carburetor Co., Detroit, one cupola from the Whiting Corp., Harvey, Ill.

Ladles

Southern Wheel Co., Cleveland, one 12-ton motor operated reservoir ladle; from the Whiting Corp., Harvey, Ill.

Molding Machines

Pratt & Letchworth Co., Buffalo, two machines; from the Herman Pneumatic Machine Co., Zelienople, Pa.

Shakeout Equipment

Dayton Steel Foundry Co., Dayton, O., West Steel Casting Co., Cleveland, shakeout bails; Modern Foundry Co., Cincinnati, Henry Furnace Co., Medina, O., XXth Century Heating & Ventilating Co., Akron, O., Ford Motor Co., Detroit, vibrator and shakeout equipment; from the Stoney Foundry Engineering & Equipment Co., Cleveland.

Tumbling Barrels

Cadillac Motor Car Co., Detroit, one 36 x 72-inch tumbling barrel from the Whiting Corp., Harvey, Ill.

NEW ENGLAND MARKET

Core Ovens

Sullivan Machinery Co., Claremont, N. H., four core ovens from Frederic B. Stevens, Inc., Detroit.

Furnaces

Sullivan Machinery Co., Claremont, N. H., one aluminum melting furnace from the Campbell-Hausfeld Co., Harrison, O., through Frederic B. Stevens, Inc., Detroit.

Molding Machines

General Electric Co., Everett, Mass., two molding machines from the Herman Pneumatic Machine Co., Zelienople, Pa.

New Trade Publications

RECORDING VOLTMETERS—Bristol Co., Waterbury, Conn., has issued a catalog covering its various types of recording voltmeters, well illustrated to show the instruments, their operation and application to various purposes.

The catalog is uniform with others by this company, for filing in its binder set.

OIL CIRCUIT BREAKERS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. has issued a leaflet describing a type of its motor starting oil circuit breaker. It covers manual operation, indoor service, nonautomatic starting position and automatic running position. Tables show ratings for motor starting breakers and losses of the breakers of this type are given.

STOKERS—A traveling grate stoker to burn a wide range of fuels, especially adapted to small sizes of anthracite and coke breeze, is featured in a bulletin by the Combustion Engineering Corp., New York. Details of construction are shown in illustrations and a table showing evaporation tests is included.

ELECTRICAL ACCESSORIES—Ohio Brass Co., Mansfield, O., manufacturer of insulators, trolley and line materials, rail bonds, car equipment and mine materials, has issued an enlarged catalog of its products, thumb-indexed and with cross references. It contains many helpful suggestions for installation.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Arizona Iron Works, Phoenix, Ariz., is having plans drawn for a 1-story machine shop.

R. D. Grier & Sons Co., Salisbury Machine Works, Salisbury, Md., is building a foundry to double its capacity.

Builders Iron Foundry, Kingsley avenue, Providence, R. I., Z. Chaffee president, will build a 1-story foundry.

Lynn Foundry Co., 993 Broad street, Lynn, Mass., will build a 1-story foundry to replace one recently burned.

Peerless Foundry Co., 1853 Ludlow avenue, Indianapolis, is building a 1-story foundry 67 x 162 feet.

Conemaugh Iron Works, Blairsville, Pa., C. C. Adams general manager, is planning a 1-story addition to be erected early in 1927.

Southwark Foundry & Machine Co., Washington avenue and Fifth street, Philadelphia, will build a 1-story machine shop addition.

Carteret Foundry Co., 2 Pacific avenue, Jersey City, N. J., will rebuild burned portion of its foundry.

Phoenix Brass Foundry Inc., 360 Coit street, Irvington, N. J., will build a 1-story addition to its plant.

J. S. Heath Co., Market street, Waukegan, Ill., brass and bronze specialties, will build a 1-story plant 100 x 250 feet. R. O. Allexan is general manager.

Marine City Motor Castings Co., Marine City, Mich., will build two additional structures at its plant, increasing floor space 6000 square feet.

St. Johns Foundry Co., St. Johns, Mich., has had plans drawn for a 1-story foundry addition to provide larger production of automotive castings and machinery dies.

General Motors Corp., Pontiac, Mich., has plans for a foundry building for the Pontiac plant including four units with capacity of 300 tons of castings per day.

Woodward Pattern Works, 321 North Michigan avenue, South Bend, Ind., will build a 1-story plant 40x100 feet. M. E. Smith, 323 South Main street, is architect.

Acme Steel & Malleable Iron Works Inc., C. Swallow manager, 245 Military road, Buffalo, N. Y., will build a 1-story addition 60x 220 feet.

Firestone Foundry & Mfg. Co., Ashland, O., has been incorporated with $50,000 capital by J. H. Firestone, J. B. Firestone, O. D. Firestone, S. Miller and E. M. Armstrong.

Troy Match Plate Co., Troy, O., has increased its space by a new building to be devoted to production of brass and aluminum castings.

Home Aluminum & Bronze Co., Piqua, O., manufacturer of nonferrous castings, has moved into its new plant at Downing and Commercial streets.

Builders Iron Co., Inc., Hartford Conn., has been incorporated to manufacture metal products by Harry A. Leonard president, George W. Lyons vice president, and Louis A. Marshall secretary-treasurer.

National Radiator Co., New Castle, Pa., R. S. Waters secretary, Johnstown, Pa., is building a foundry 130 x 356 feet, assembly and shipping building 190 x 432 feet and coke shed 24 x 130 feet.

De Sanno Foundry & Machine Co., 2941 East Twelfth street, Oakland, Calif., has bought a site on East Fourteenth street and is considering plans for a foundry and machine shop.

Lansdale Foundry Co. Inc., Lansdale, Pa., has been incorporated with $100,000 capital to manufacture gray iron castings by Joseph H. Rettig, 402 East Mt. Riry avenue, Philadelphia. H. N. Rettig, and Edward B. Quernor.

Barnes Mfg. Co., 701 North Main street, Mansfield, O., manufacturer of pumps, has plans drawn by George S. Rider Co., Century building, Cleveland, for a 1-story foundry 52x185 feet.

Rogers Foundry Co., Pearl and Tenth streets, Joplin, Mo., has let contract to Concrete & Steel Construction Co. for an addition 50x100 feet, for which equipment will be required.

After being idle for more than a year, plant No. 2 of the Atlas Foundry Co., Marion, Ind., has resumed operations. Plant No. 1 has been working night and day in an attempt to keep up production.

C. H. Turner Co. and C. H. Turner Foundry Co., Statesville, N. C., have consolidated under the name of the C. H. Turner Mfg. Co. and will continue the manufacture of special machinery.

Additional information from the Keokuk Steel Casting Co., Keokuk, Iowa, states that contract was let for two additions, one 20 x 133 feet and the other 99x144 feet instead of one 36x277 feet as noted in the Nov. 15 issue.

Headlight Stove Corp., 623 West Washington street, Chicago, has been incorporated with $70,000 capital to manufacture stoves, heaters, garbage burners and water heaters by L. A. Althoff, M. F. Althoff and A. V. Anthony.

Hancock Mfg. Co., Charlotte, Mich., H. W. Hancock president, manufacturer of automobile hardware, has bought the former plant of the Earl Motors Co., Jackson, Mich., and will utilize a portion for production of its devices.

Attleboro Specialty Co., Attleboro, Mass., has been incorporated with $10,000 capital to manufacture castings and implements, tools, fixtures and machinery by Leland B. Smith president, Attleboro; Joseph M. Washington treasurer, Andrew A. Underwood clerk.

Tonawanda Stove & Furnace Corp., Tonawanda, N. Y., has been incorporated with $10,000 capital to manufacture heating devices by O. A. Solomon, and V. W. Curtiss. R. Baxter, North Tonawanda, N. Y., is attorney.

Metropolitan Sash Weight Co., New York, has been incorporated with 100 shares no par value to manufacture sash weights and similar articles by S. Black, W. H. Callahan and R. W. Matthews. Cook, Nathan & Lehman, Trinity building, are attorneys.

Sandusky Pattern Co., Sandusky, O., has been organized and incorporated to take over the business of the National Pattern Co., of that city. F. J. Grathwol will continue as head of the company. The production of patterns will be continued.

Oklahoma Steel Castings Co., Tulsa, Okla., has let contract for an additional unit to its main plant 60x66 feet. The new unit will house the core department. Additional equipment including core ovens and sandmill installation has been purchased.

Thatcher Furnace Co., 39 St. Francis street, Newark, N. J., manufacturer of furnaces and boilers for heating, has let contract to Wigton-Abbott Corp., 552 West Twenty-third street, New York, for extensions and improvements to a plant recently bought at Garwood, N. J., 100 x 200 feet.

Pittsburgh Die Casting Corp., Swissvale, Pa., has been incorporated with $20,000 capital to manufacture metal products, machinery, tools and equipment by Frank N. Townsend, Vandergrift, Pa., H. F. Messersmith, Fittsburgh and Howard G. DeVan, Pittsburgh.

Texas Electric Steel Castings Co., Houston, Tex., has made extensive machinery additions, including a large electric furnace and electric crane of 20 tons capacity. F. A. Kroll, formerly in metallurgical engineering work in Houston, is president, and F. G. Sowden, formerly with the Minneapolis Steel & Machinery Co., is vice president.

Lycoming Mfg. Corp., Williamsport, Pa., has elected James B. Graham, formerly president, chairman of the board. John H. McCormick was elected president and general manager and W. H. Beal, formerly sales manager, was chosen secretary and sales manager. The company manufactures automotive motors and has increased production largely the past two years.

Rundle Mfg. Co., Milwaukee, manufacturer of plumbers' supplies, sanitary fixtures, etc., has increased its capitalization from $700,000 to $1,500,000. It is stated that a stock dividend of $560,000 has been declared, absorbing the greater part of the new issue. While the concern is building a large addition to its boiler house and making minor improvements in the works at Twenty-seventh and Cleveland avenues, no important expansion is contemplated at present. Henry Held is president and general manager.